DOCUMENTATION FOR THE LOWER EAST COAST FLORIDAN AQUIFER MODEL

Prepared by:

Resource Assessment Division
Lower East Coast Planning Division
SOUTH FLORIDA WATER MANAGEMENT DISTRICT

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1. OVERVIEW

A three-dimensional, steady-state, finite-difference model (MODFLOW) has been developed for the greater Lower East Coast Planing Area (including selected portions bordering Lake Okeechobee) which simulates advective flow within the Floridan aquifer system (FAS). A model-independent graphical design system, Groundwater Vistas (GV), was used to assist with both pre- and post processing of the model data sets. Horizontal discretization consists of a model grid covering an area of 16,434 sq. miles at a resolution of one square mile (Figure 1). Vertical discretization assumes a laterally contiguous layering scheme focusing on three principal flow zones within the aquifer system. Because MODFLOW cannot address the multi-density fluid conditions existing in the FAS, the model employs fresh-water equivalent head values.

2. RESULTS

The principal results of the modeling effort can be summarized as follows:

- Vertical flow contributes in excess of 86 percent of the total flow for any given layer over the entire model domain, implying that the bulk of recharge water within the FAS emanates from below. This result seems to be supported, at least in part, by earlier observations as documented by Meyer (1989).

- The overall model is more sensitive to changes in vertical than in horizontal conductivity, again suggesting that the primary flow of water through the aquifer system is in the vertical direction.

- Estimated upward flow rates to the Upper Floridan aquifer calculated over the model domain are extremely low (0.02 in/yr).

- The elongated depression identified by Johnston et al. (1981) in the potentiometric surface of the Upper Floridan aquifer in the area corresponding to the northern side of the model domain is in accord with the head distributions in the calibrated model. These investigators attribute the depression to uncontrolled flow from abandoned wells. This uncontrolled flow has ostensibly isolated a remnant of the predevelopment potentiometric surface, indicating that lateral recharge no longer enters the area from central Florida. If this feature actually is an isolated remnant "high," it would be expected to dissipate in the future with increased withdrawals from the system.

- Flow direction in the Upper Floridan is predominantly eastward. Within the Lower Floridan aquifer, the westerly flow trends are commensurate with the conceptualization of flow proposed by Kohout et al. (1977). However, a lack of data combined with associated errors makes these trends highly questionable.

- The majority of lateral outflow from the model area occurs within the three flow zones, with those in the Upper Floridan exhibiting higher rates.

- Most model layers show an increase in the Kx/Kz anisotropy ratio. Whether this ratio is real or an artifact of the modeling process is uncertain at this time.

3. MODEL LIMITATIONS

As with any model, this one is not without its limitations. Three principal areas of uncertainty exist which include: 1) the hydrostratigraphic conceptualization, 2) ill-defined boundary conditions along the inland portions of the model, and 3) the utilization of a non-density dependent flow regime. Because this model represents a simplistic conceptualization of the FAS, additional data and model verification may be needed when the model is applied to simulate a specific problem. Users should carefully consider the following model limitations:

- The model assumes laterally continuous flow zones whereas the data suggests that this is not the case. Actual zones may not be interconnected throughout the model domain and may be vertically offset. For example, at the Jupiter ASR facility, flow zones in wells 5600 feet apart differ in elevation by 140 ft.

- Model flow zones represent an aggregate of multiple flow horizons, whereas aquifer data suggests that the overall contribution to flow is limited to narrow, individual flow horizons.

- Model calibration is contingent on the accuracy of well pressure data which appears to be subject to various uncertainties. Unexplained pressure fluctuations are evident in many of the data sets synthesized for the model.

- Synthesis of data from diverse sources of information is complicated by the differing criteria and judgements used by various authors in delimiting hydrostratigraphic zones.

- Limited data exists with respect to aquifer parameterization. The majority of information is derived from either ASR/RO projects concerned with discrete zones within the Upper Floridan or UIC investigations focused on the Boulder zone and its overlying confining beds. In addition, any hydraulic parameters derived from discrete intervals have been extrapolated to the broader, aggregated flow zones depicted in the model.

- The degree of confinement between flow zones is speculative at best, as data on vertical hydraulic conductivity is very sparse. Even where more detailed discrete data is available, the efficacy of areal predictions on confinement is uncertain. For example, upward migration from the Boulder Zone across the overlying confining unit has been documented within the UIC program (Ron Reese, USGS, personal communication, 6/98).

- The model assumes intergranular, laminar flow when, in fact, the flow regime within the Floridan aquifer represents conduit flow which may produce turbulent conditions; especially in areas stressed due to withdrawals. Therefore, this assumption becomes less valid with a decrease in grid size near stressed locations.

- High Kx/Kz anisotropy ratios found for many layers in the model may occur as a result of: 1) over-estimation of flow volumes for a given head distribution due to the misapplication of a porous media model to a karstic or block-fissure system, and 2) over-estimation of vertical flow gradients due to errors inherent in the FWE head conversion process (as magnified with increased depth and/or TDS concentration).

- The application of particle tracking in aquifers exhibiting conduit flow may be inappropriate due to the tortuous nature of the flow regime. The user should at least exercise caution in establishing grid size when utilizing this technique.

- The use of freshwater equivalents heads is not an entirely satisfactory substitute for the actual water density differences encountered in the FAS. For ASR assessments, the present model cannot address the buoyancy effects associated with a resident fresh water bubble. Thus, the accuracy of vertical confinement predictions is deficient in proportion to the degree of density contrast. For RO assessments, the present model is unable to address issues relating to water quality such as upconing.

4. MODEL FORMULATION

The ensuing discussion pertaining to model input refers to the formats required by the pre-processor in GWVISTAS. If desired, these data sets are available to the user upon request. Because it is assumed that most users will be employing the USGS MODFLOW code directly, a listing of all MODFLOW data files used is included in Appendix 1.

4.1. Hydrostratigraphy

Methods and limitations. Three flow zones were conceptualized within the FAS: two in the Upper Floridan and one in the Lower Floridan (Figure 2). Geologically, flow zone #1 (in the Upper Floridan aquifer) encompasses permeable zones occurring at or near the top of the Avon Park Formation and the Ocala Limestone, where the latter is present. Flow zone #2 (in the Upper Floridan) encompasses producing zones within the upper part of the Avon Park. Flow zone #3 (in the Lower Floridan aquifer) is an aggregate of the shallowest producing intervals at or near the top of the Oldsmar Formation. Information on the character and nature of flow zones within the FAS is provided by Meyer, 1989; Brown and Reece, 1979; and Reese, 1994. For modeling purposes, the flow zones as well as the lower permeability units encountered within the aquifer system were discretized into nine layers.

Table 1 contains the elevations corresponding to the surficial aquifer and flow zone model layers at given locations. Hydrostratigraphic picks for model layers 1 through 7 were based primarily on information presented by CH2M Hill (1995) in a report prepared for the South Florida Water management District (SFWMD). As referenced in the table, additional information was obtained from various SFWMD and consultants reports. Picks for model layers 8 and 9 were derived from the above sources and/or the structure contour maps presented by Miller (1986) of the top and bottom of the Boulder Zone (layer 9).

The varied nature and spatial coverage of the information available from the aforementioned sources makes regional hydrostratigraphic delineation of flow zones very difficult. In addition, aquifer data suggests that the overall contribution to flow is limited to narrow, individual flow horizons. Thus, it should be borne in mind that the depiction of separate, extensive and laterally continuous flow zones throughout the model area is a conceptual simplification.

Resulting model input. The model consists of nine layers arranged as follows:

Layer 1 – Surficial Aquifer System (handled as an upper boundary condition)
Layer 2 – lower permeability unit
Layer 3 – upper flow zone within the Upper Floridan Aquifer **(FLOW ZONE #1)**
Layer 4 – lower permeability unit
Layer 5 – lower flow zone within the Upper Floridan Aquifer **(FLOW ZONE #2)**
Layer 6 - Middle Confining Unit of the FAS
Layer 7 – upper flow zone within the Lower Floridan Aquifer **(FLOW ZONE #3)**
Layer 8 – lower permeability unit
Layer 9 – base of the Floridan Aquifer System (i.e., the Boulder Zone within the lower Oldsmar Formation) (handled as a lower boundary condition)

Model data sets pertaining to layer bottom elevations were prepared in SURFER (by applying the Kriging algorithm to the spot elevation data) and output directly for the model in SURFER grid file format.

<u>4.2. Aquifer Parameters (K, K')</u>

Methods and limitations. As a first step, model layer assignments were made based on values of horizontal and vertical hydraulic conductivity available at a given site. Geometric means were then calculated for each suite of values falling within a given layer at that site. Final values representing the geometric mean of all the geometric mean values for a given layer were ultimately calculated for each layer. These computed values, as well as site locations and associated references, are presented in Table 2.

Given the sparsity of existing data in both the vertical and horizontal realms, coupled with the large variation of values typically encountered at any one location for a given layer, regional mapping of hydraulic parameter values was not deemed appropriate. Therefore, a uniform value representing the final geometric mean for a given layer was computed and assigned.

Resulting model input. Initial hydraulic conductivity values were directly input into the model by hand. Each model layer was uniformly assigned the geometric mean of the site-specific geometric mean values of vertical and horizontal K computed for that layer.

4.3. Wells (Pumping Facilities)

Methods and limitations. Four facilities imposed stresses on the Upper Floridan Aquifer during the 1995-1997 model calibration period. However, only the Boynton Beach ASR and Jupiter RO facilities operated throughout the entire period and therefore are included in the Wells Package. In addition to these operations, the City of Hollywood reportedly performed a small (~10,000 gallon) RO pilot study during a few days in 1995, and the City of Deerfield Beach performed a similar study over a period of 63 days (1.8 million gallons total) between March and May of 1997. These stresses, however, are not represented in the model due to their small magnitude and duration relative to the temporal and spatial scales of model simulation.

Resulting model input. Tables 3 and 4 present the location coordinates, depths, and injection and/or withdrawal rates associated with the Boynton Beach ASR and Jupiter RO facilities respectively. These rates were converted to ft3/day and input directly into the model by hand at the locations depicted in Figure 3.

4.4. Initial Heads and Boundary Conditions

Methods and Limitations. Starting heads used for the model layers and associated boundary conditions were derived principally from pressure data, which was subsequently converted to fresh-water equivalent heads spanning a three year period of record (POR). This conversion was necessary for two reasons: 1) MODFLOW requires head estimates rather than pressures in order to numerically solve the flow equation and 2) the conversion serves to "standardize" the observed pressures reflecting varying fluid densities.

The pressure data was obtained from two principal sources: the SFWMD and FDEP. Within the model area, the SFWMD maintains a network of 29 Floridan wells, 20 of which are sampled on a monthly basis and 9 of which are sampled quarterly. In addition, 104 well records (consisting of monthly operating reports) were obtained from the FDEP which inventories all utilities applying for and/or maintaining a Floridan Class 1 Injection Well. Included in these records are the associated monitor well pressures obtained above the injection zone (typically cited as maximum monthly pressure). As a result, the combined database reflects a composite of monthly spot and maximum monthly values ranging over a three-year POR (95-97). The aggregation of values is not considered a problem if one assumes a negligible temporal variation because of the lack of stresses (primarily withdrawals) imposed on the upper and middle portions of the FAS, specifically within the principal flow zones. The data was screened for anomalous values and a median fresh-water equivalent head value was calculated for each well as representative of steady-state conditions. Twenty-six (26) District wells and 47 utility wells compose the final data set. In some cases the open screen interval of the wells in the final data set overlapped more than a single model layer, and this factor had to be qualitatively considered as an additional source of error in analyzing the head distributions.

The head distribution for all layers, excluding layer 1, was produced by applying the method of trend-surface analysis. Trend-surface analysis provides a mathematical method of separating local fluctuations from the regional component of a spatial data distribution. The data are approximated by a polynomial function whose coefficients are found by the method of least squares, thus insuring that the sum of the squared deviations from the trend surface (residuals) are minimized. The polynomial can be expanded to any desired degree so as to encompass more of the variability in the data. In effect then, the trend surface acts as a variable "noise" filter with the aim of extricating regional patterns from data containing localized fluctuations. The head distributions in layers 3, 4, 5 (combined into one layer given the inter-layer head similarities), 7 and 9 were derived directly from trend surface analysis applied to the associated data existing within those layers. A third-order polynomial was utilized for layers 3, 4, 5 (combined) and a first-order for layers 7 and 9, respectively. Due to the spatial distribution and number of data points in layers 2, 6, and 8, head distributions for these were derived from the trend-surface values for adjacent layers using qualitative judgements. Head values for layer 2 are weighted composites derived from the sum of 0.25x and 0.75y, where x and y are the trend-surface values for layers 1 and 3, respectively. Values for layer 6 are weighted composites derived from the sum of 0.75x and 0.25y, where x and y are the trend-surface values for layers 3, 4, 5 (combined) and 7, respectively. Values for layer 8 represent the trend-surface values for layer 7 plus 5 ft based on spot-value head differences between these layers. The head distribution in layer 1, which represents the Surficial Aquifer System, was constructed from a series of 7.5 minute topographic maps by subtracting 2.5 feet from the existing ground surface elevations and assigning a constant value of 15.4 feet to Lake Okeechobee representing the average lake stage for the model POR. Figures 4 through 10 depict the initial head distributions for layers 1 through 9 respectively.

For those layers incorporating the Upper Floridan aquifer (i.e., layers 3, 4, & 5) the final trend surface compares favorably with published potentiometric maps (refer to Johnston, Healy, and Hayes, 1981). For those layers incorporating the Lower Floridan aquifer (i.e., layers 7, 8, & 9), the trends conform to the conceptualization of flow proposed by Kohout et al. (1977). However, a lack of data combined with associated errors makes these trends highly questionable.

Six flow boundaries are imposed on the model domain: four in the lateral realm and two in the vertical realm. Laterally, the model boundaries extend as follows: along a ten mile radius surrounding Lake Okeechobee across Martin, St. Lucie, and Okeechobee Counties to the north; into the western edges of Glades, Hendry, Collier, Palm Beach, Broward, and Miami-Dade Counties following a NW-SE trending Upper Floridan ground-water divide; and out to the Atlantic Ocean following the continental shelf to the east (Figure 11). These boundaries are represented as general head boundaries whose stage is set to the initial heads at those cell locations. Vertically, layers 1 and 9 (representing the Surficial Aquifer and Boulder Zone respectively) are assigned as constant head boundaries reflecting the trend surface heads.

Resulting Model Input. The initial heads were processed in SURFER and output to the model in SURFER grid file format. The flow boundary inputs were created as ASCII files, with each file formatted according to boundary condition type. The GHB file format consists of one line of input per boundary cell specifying row, column, layer, head, cell length, cell width, hydraulic conductivity, and layer thickness. The constant head file format consists of one line of input per boundary cell specifying the x coordinate, y coordinate, and head.

5. CALIBRATION AND SENSITIVITY ANALYSIS

Methods and Limitations. Unlike a standard calibration approach which uses actual head measurements as calibration targets, the approach taken with this model was to use trend surface heads instead. As alluded to in section 2.4, the various trend surfaces generated emphasize regional variations as opposed to localized effects. Because such local variations are probably artifacts of the data quality (i.e., data error), it was considered that calibration to the regional trends identified with the trend surface analysis was the only feasible way to proceed.

Numerous steady-state calibration simulations were made, through trial-and-error, in an effort to mimic the trend surfaces for the various model layers. The hydraulic parameters modified between simulations consisted of horizontal and vertical conductivity, and boundary conductance for layers 2 through 8.

Areal discretization of hydraulic parameters is not justified due to the sparsity of conductivity data in both the vertical and horizontal realms. Consequently, modifications in all cases consisted of assigning a uniform conductivity value throughout the entire model layer. In achieving calibration, this value was not allowed to exceed the “order of magnitude” of the median raw data. This approach maximizes impacts due to pumping stresses and is commensurate with the Regulation Department’s intended application of the model to conservatively access impacts on the FAS.

Transient calibration of the model is not warranted given the lack of stresses on the system and the numerous uncertainties associated with the well pressure data (e.g., tidal and barometric pressure effects, measurement errors, gauge errors, etc).

Resulting Model Output and Sensitivity of Calibration. One of the advantages in employing GV as a modeling tool is that it couples model design with graphical analysis. As a result, during model construction and runs, the model design is displayed in both plan and cross-sectional views on the screen (using a split window) and results are presented using contours, shaded contours (color flood), velocity vectors, mass balance analysis, and various calibration statistics. These features greatly assisted in the model calibration process. For purposes of discussion, various tables and figures resulting from this process are presented in this report.

Tables 5 through 9 contain the calibration targets and associated statistics for model layers 3 through 7. These targets represent locations of actual monitoring wells for any given model layer. Because of the absence of targets in both layers 2 and 8, the heads for these layers were not directly calibrated but instead were allowed to vary in response to the model solution. A layer was considered calibrated when the model head distribution reasonably matched the calculated trend surface as depicted in Figures 12 through 16. This resulted in an acceptable range of residual means smaller in magnitude than the estimated uncertainties inherent in the data.

Table 10 compares the final calibrated hydraulic conductivity values with the initial estimates. As evidenced in this table, five of eight layers show an increase in the Kx/Kz anisotropy ratio. Whether, in these instances, this ratio is real or an artifact of the modeling process is uncertain at this time. However, there are at least two possible causes as to why the high anisotropy ratios may occur as a result of the modeling process alone: 1) over-estimation of flow volumes for a given head distribution due to the misapplication of a porous media model to a karstic or block-fissure system, and 2) over-estimation of vertical flow gradients due to errors inherent in the FWE head conversion process (as magnified with an increase in depth and/or TDS concentration).

Table 11 summarizes the model mass balance for all model layers. As evidenced over the entire model domain, vertical flow contributes in excess of 86 percent of the total flow for any given layer. If this is true, the implication is that bulk of recharge water within the FAS emanates from below. This result seems to be supported, at least in part, by the observations of Meyer (1989), who states that " Ground-water movement in southern Florida is estimated to be chiefly upward from the Lower Floridan aquifer through the middle confining unit, then horizontally toward the ocean through the Upper Floridan aquifer.". The question as to why higher salinity values are not evidenced at this time within the Upper Floridan is most likely related to the relatively slow rates of leakage occurring from below this aquifer as compared with lateral flow rates within it. Table 12 indicates a three order of magnitude difference between the lateral and vertical flow rates calculated within layer 3 (5.86 in/yr as compared to 7.59e-03 in/yr). In addition, the table indicates that vertical leakage across the Lower Floridan is occurring at approximately 1.56e-02 in/yr (~600 ft per one million years).

Pumping stresses in existence during the calibration period do not produce any significant impact(s) on the regional head distributions within their respective areas, due to the relatively low injection and withdrawal rates applied to zones displaying high transmissivity. As a result, standard history matching to local stresses is not feasible. However, a sub-regional qualitative assessment of pumping stress was made by comparing a steady-state model run to the hypothetical results of a 1975 feasibility study conducted by Dames & Moore at FPL's Turkey Point facility in southern Miami-Dade County. The study evaluated the water supply potential of the Upper Floridan aquifer in meeting large volume, long-term withdrawals for use as a cooling medium. Based on aquifer parameters derived from pump test results, an analytical solution was applied to large-scale pumping stresses (70 mgd) over a 40-year period to predict the zone of influence. Figure 17 displays the analytical results super-imposed upon the model results. Despite the differences in conceptualization between the two methods and the limiting assumptions inherent in the analytic solution, comparison of the results of both methods is favorable. Apart from offset zones of influence and differing hydraulic gradients, the 10-foot drawdown contours encompass an area of approximately 804 square feet. The offsets are most likely the result of over-simplified boundary conditions (both in location and extent) as applied to the analytical solution. The hydraulic gradient resulting from the analytical solution is shallower than the gradient resulting from the numerical solution. However, this is also to be expected as a result of the differing boundary conditions coupled with differences in transmissivity between the two methods.

Sensitivity analysis was performed on the calibrated model to ascertain the dependency of the results on the estimated aquifer parameters used. The parameters altered in this analysis consisted of layer hydraulic conductivity (both vertical and horizontal) and GHB conductance. These parameters were selectively increased and decreased by two orders of magnitude from the base (calibrated) values and the resulting overall head changes examined to determine the relative magnitude of sensitivity response. It was assumed that testing this range of values would bracket a "reasonable" interval of uncertainty for each of the parameters. The results of these analyses are presented in Tables 13-15 for layers 2 through 8. The sensitivity statistics include the sum of squares, residual mean (mean error), residual standard deviation (root mean squared error), average drawdown, and constant head flux change. In summary, the following conclusions can be made:

- The sensitivity analysis suggests that the overall model is more sensitive to changes in vertical than horizontal conductivity, further corroborating the finding that the primary flow of water through the aquifer system is in the vertical direction. Furthermore, the model is most sensitive to changes in horizontal K within layers 3 and 5 in the Upper Floridan and to changes in vertical K within layers 7 and 8 in the Lower Floridan.

- In general, the model is more sensitive to changes in vertical K within the Lower Floridan (layers 6, 7 and 8) than within the Upper Floridan. Within the Upper Floridan, the model is more sensitive to changes in vertical K within the lower-permeability layers (layers 2 and 4). The model is less sensitive overall to changes in vertical hydraulic conductivity within layers 3 and 5 in the Upper Floridan due to the contrast in the magnitude of assigned vertical K values between these and the other layers.

- In terms of horizontal hydraulic conductivity, the model appears to be most sensitive to changes within layers 3, 5, 6 and 7, in that order. The model proved relatively insensitive to changes made within layers 2, 4 and 8. However, this result is not unexpected as these layers have calibrated average transmissivities one to two orders of magnitude lower than the aforementioned layers.

- The model is relatively insensitive to changes in GHB conductance except in layer 2. This appears to be directly related to the contrast in vertical hydraulic conductivity between layer 2 and the rest of the model layers. The calibrated vertical conductivity value in layer 2 is two orders of magnitude lower than that in the other layers. Given the predominance of vertical flow in the model, and layer's 2 role as an "outlet" at the terminus of this flow system, the GHB conductance term becomes paramount in the layer's ability to transmit water at the boundaries.

Certainly, one of the most useful outcomes of any model sensitivity analysis is to assist in making decisions regarding data collection efforts necessary to enhance parameter accuracy. The results should be directly applicable to the physical system assuming that the model is based on a valid conceptualization and parameterization of the flow system. However, if these assumptions are invalid, which is quite plausible given the shortcomings identified in previous sections, then any decisions made regarding data collection based on sensitivity analysis alone would be tenuous at best.

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FIGURES

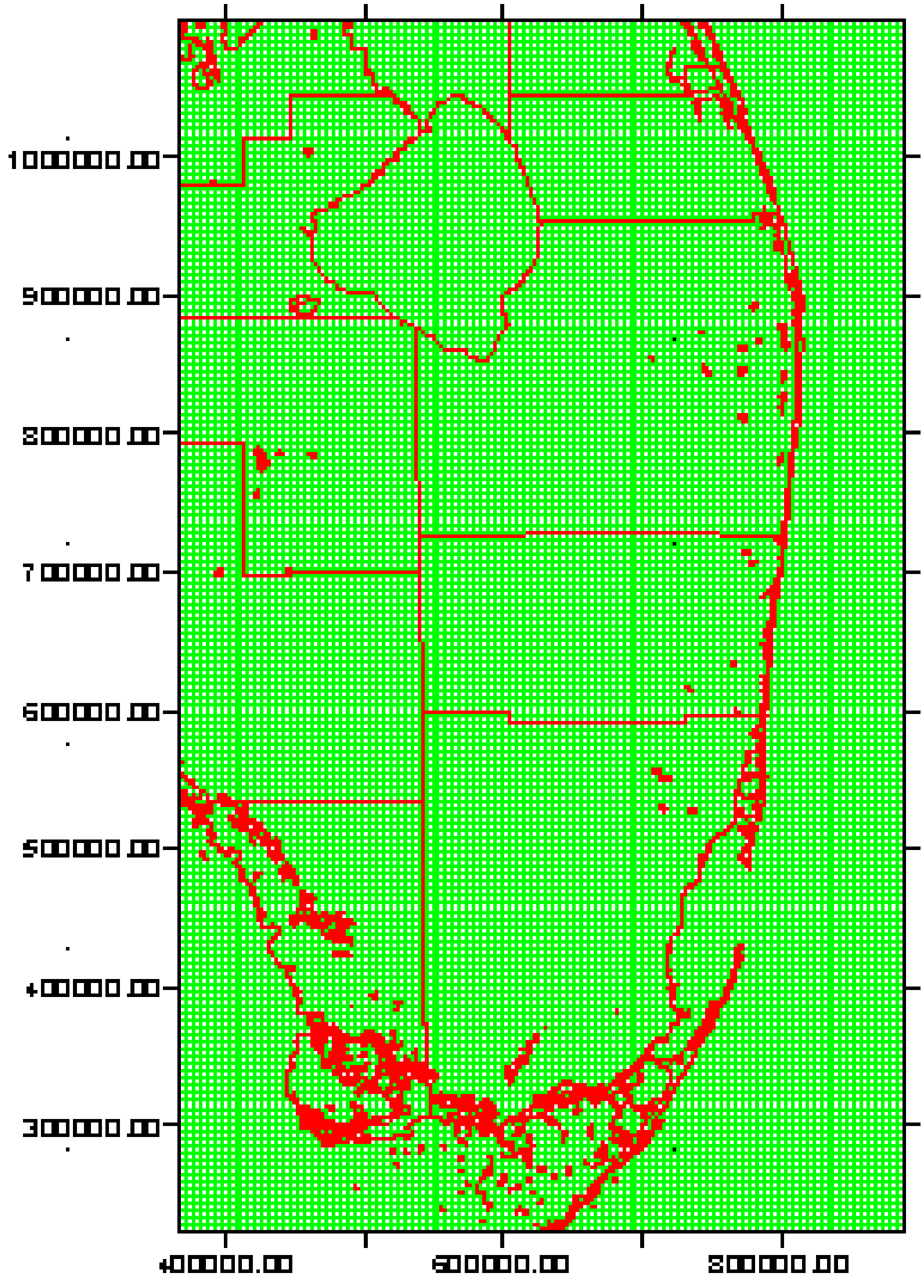
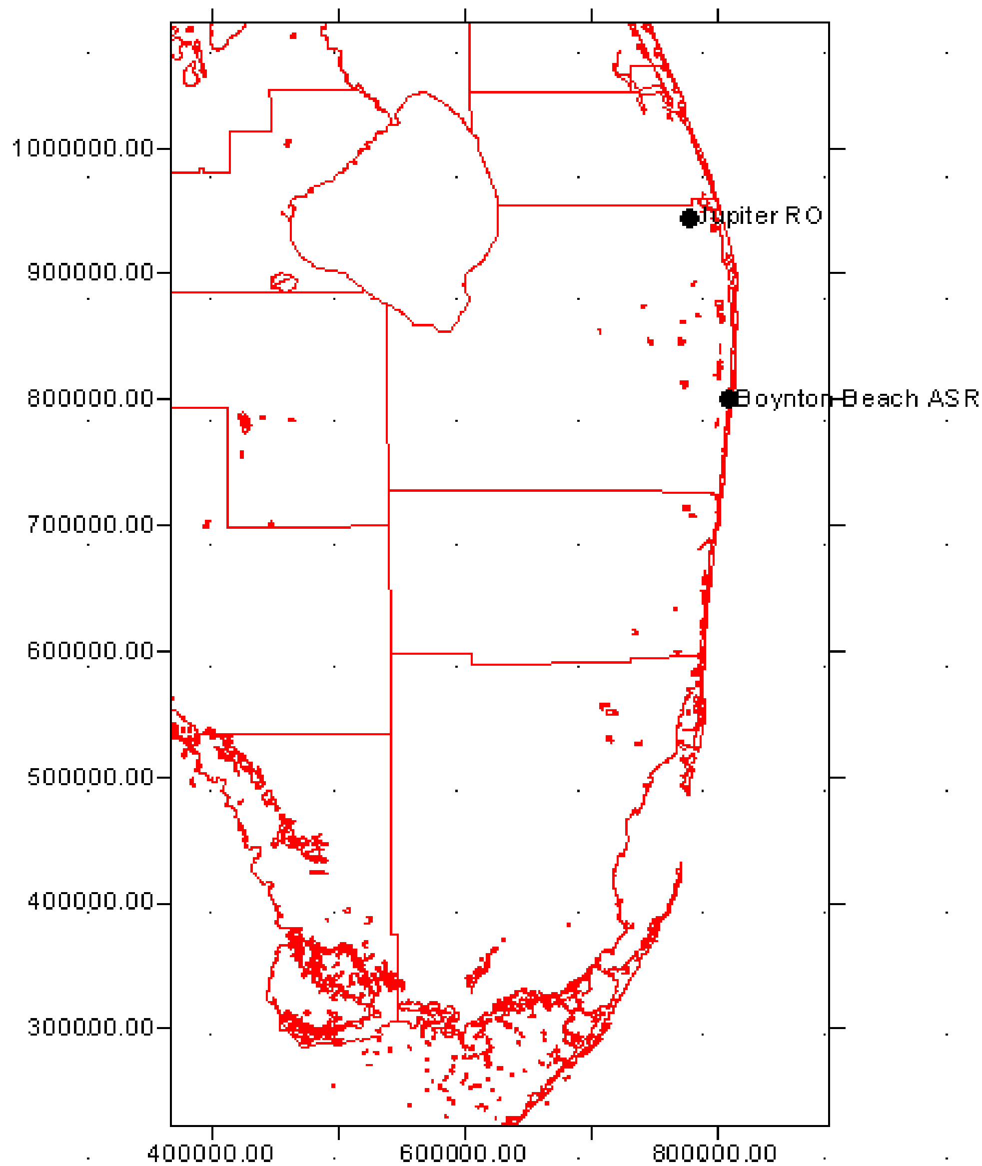


Figure 1. Model Grid Domain.

<table>
<tr><th>Aquifer</th><th>Formation</th><th>Flow Zone</th></tr>
<tr><td>Surficial System</td><td></td><td></td></tr>
<tr><td>Confining Units</td><td>Hawthorn Group
(Peace River & Arcadia)</td><td></td></tr>
<tr><td rowspan="6">Upper Floridan</td><td rowspan="2">Suwannee</td><td></td></tr>
<tr><td rowspan="3">Composite Flow Zone
1</td></tr>
<tr><td>Ocala</td></tr>
<tr><td rowspan="4">Avon Park Limestone</td></tr>
<tr><td></td></tr>
<tr><td>Composite Flow Zone
2</td></tr>
<tr><td rowspan="2">Middle Confining Unit</td><td rowspan="2"></td></tr>
<tr><td rowspan="2">Lake City Limestone</td></tr>
<tr><td rowspan="3">Lower Floridan</td><td rowspan="2">Composite Flow Zone
3</td></tr>
<tr><td rowspan="2">Oldsmar Limestone</td></tr>
<tr><td></td></tr>
</table>

Figure 2. Flow Zone Conceptualization.



• Well location

Figure 3. Pumping Well Centers.

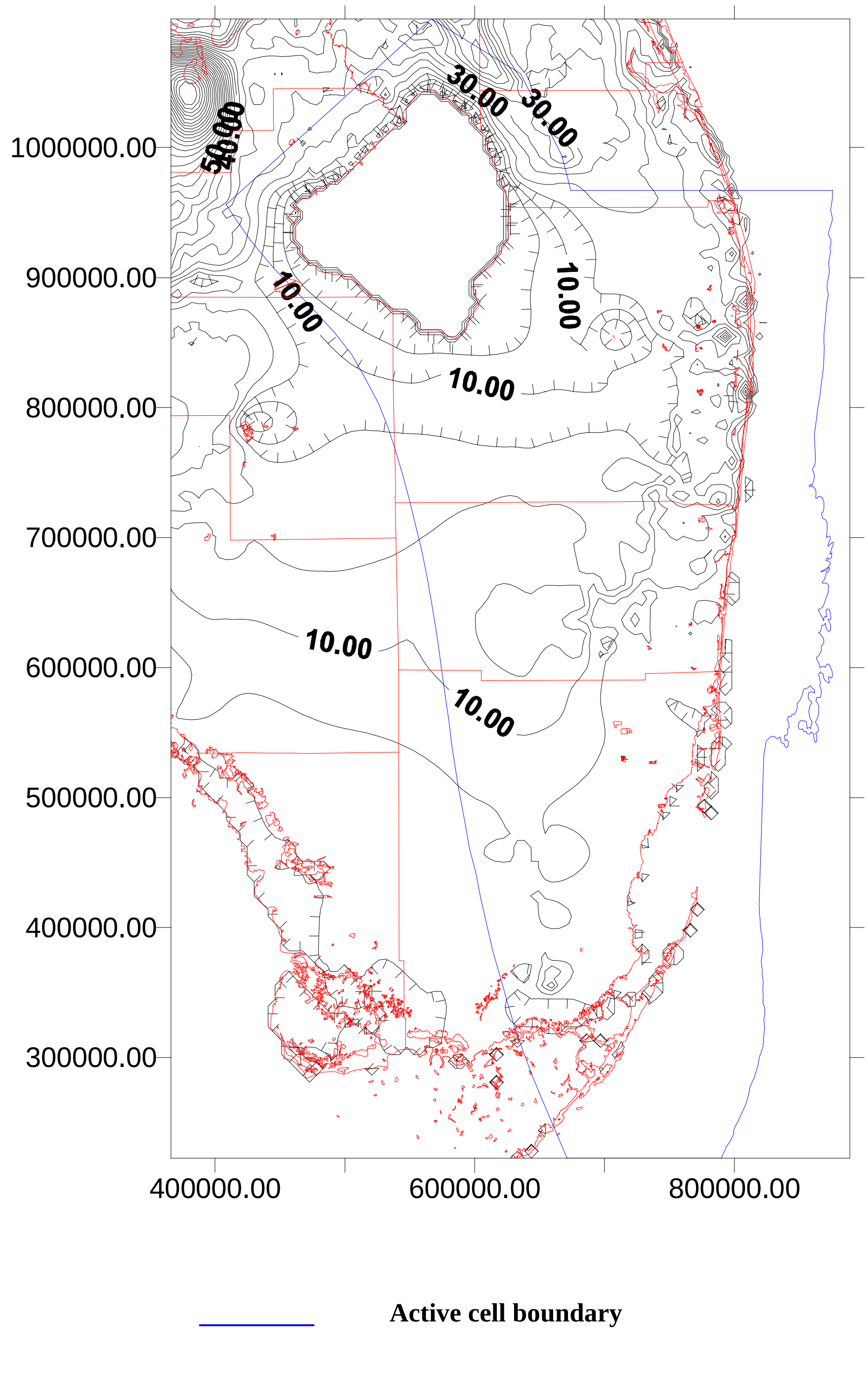


Figure 4. Initial Head Distribution – Layer 1.

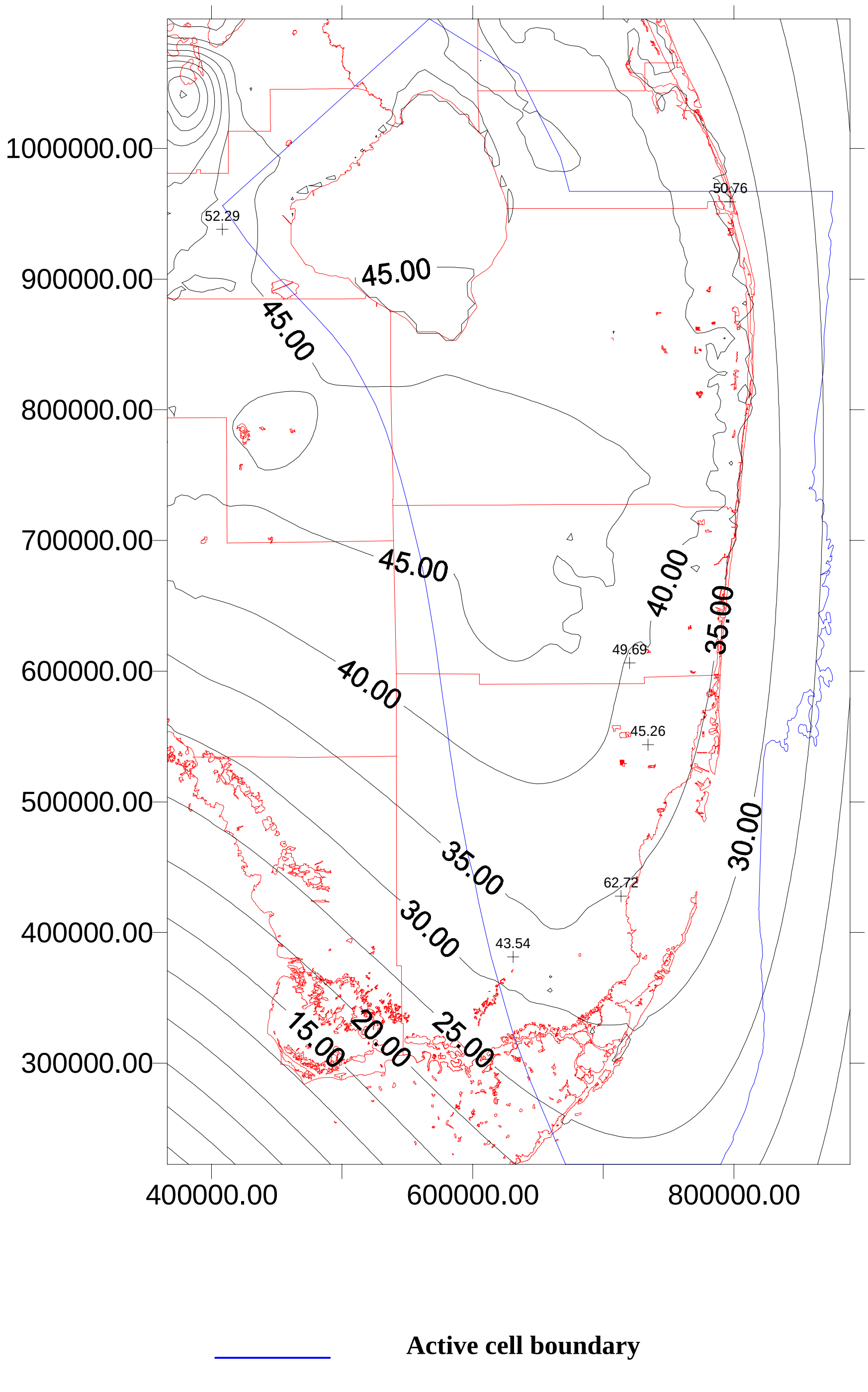


Figure 5. Initial Head Distribution – Layer 2.

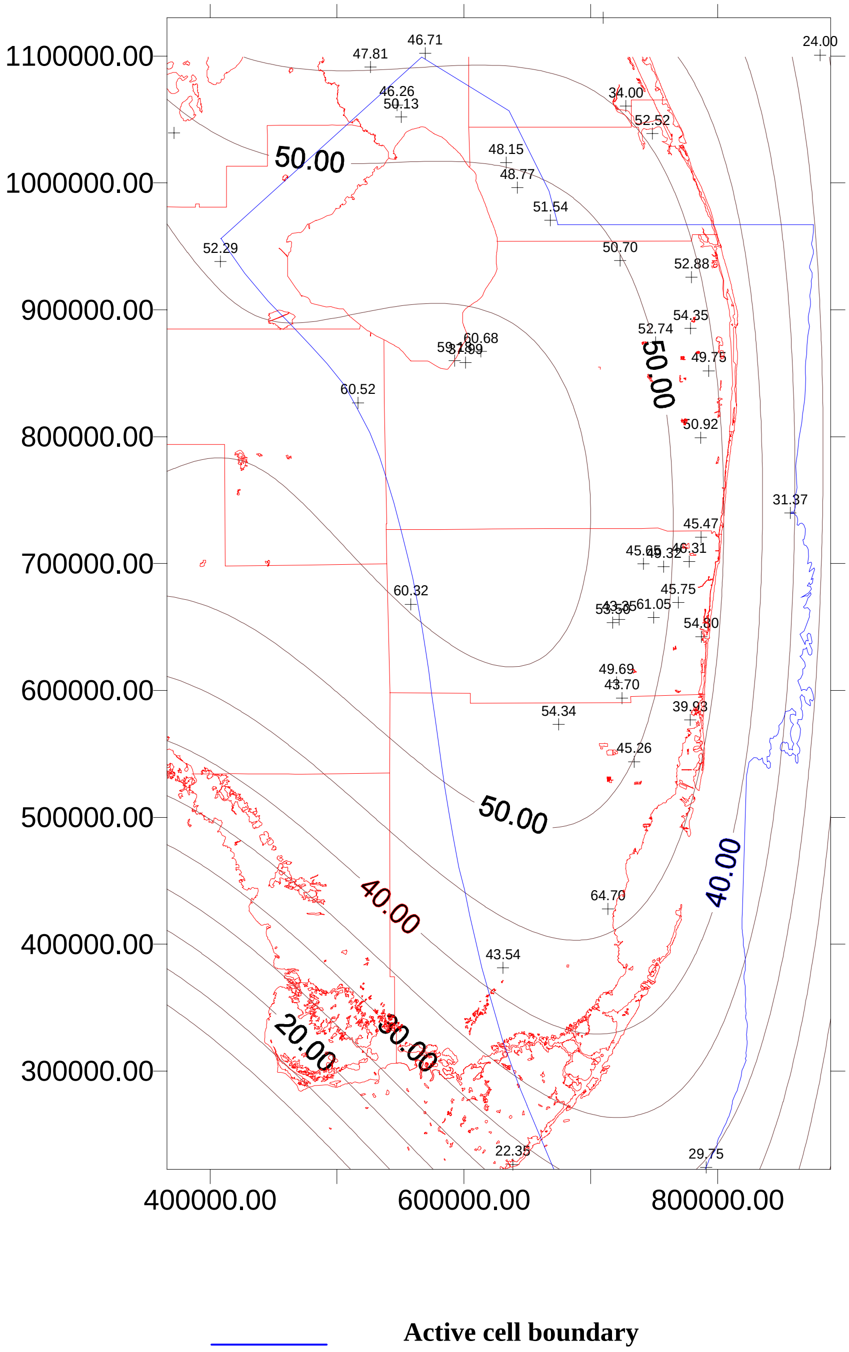


Figure 6. Initial Head Distribution – Layers 3,4,5.

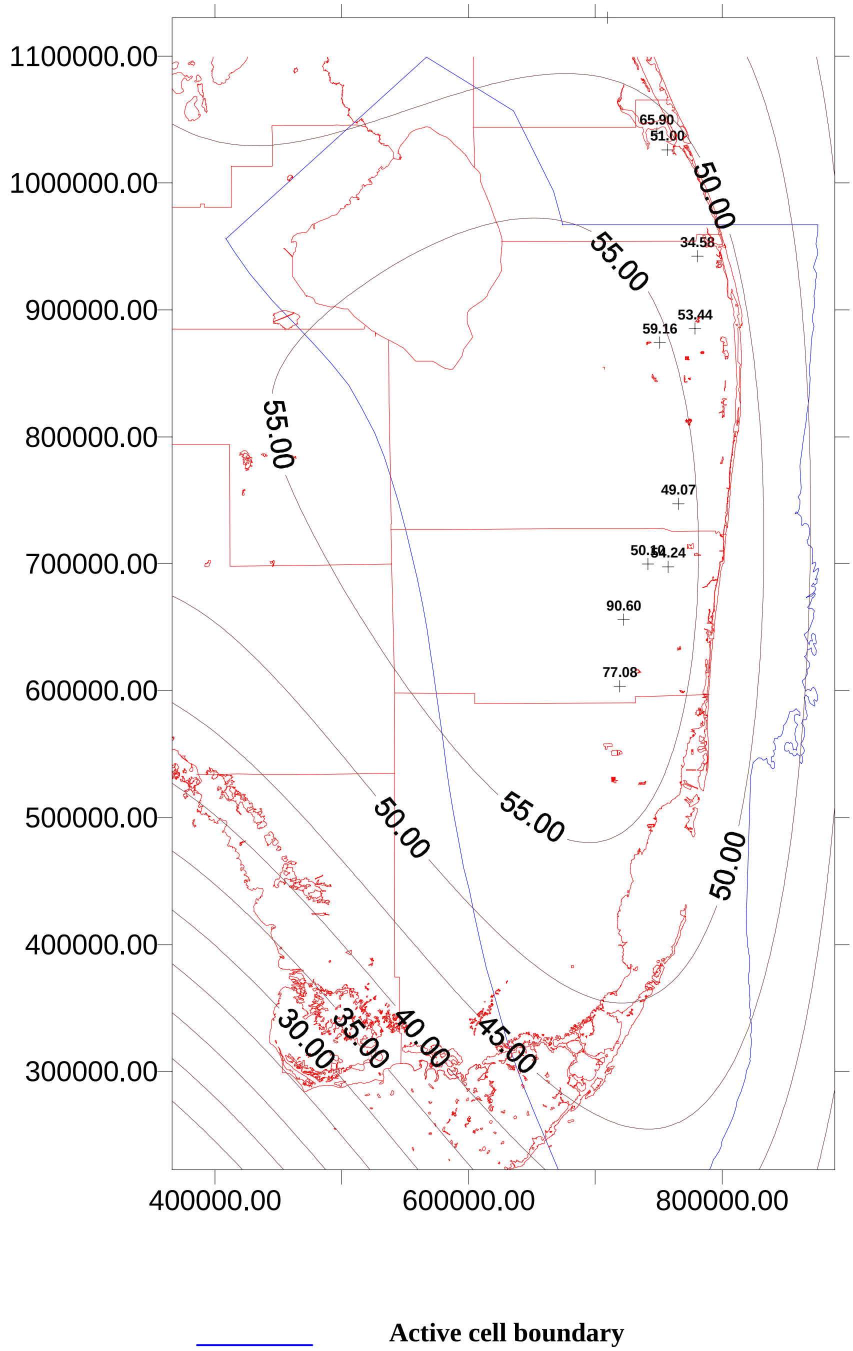


Figure 7. Initial Head Distribution – Layer 6.

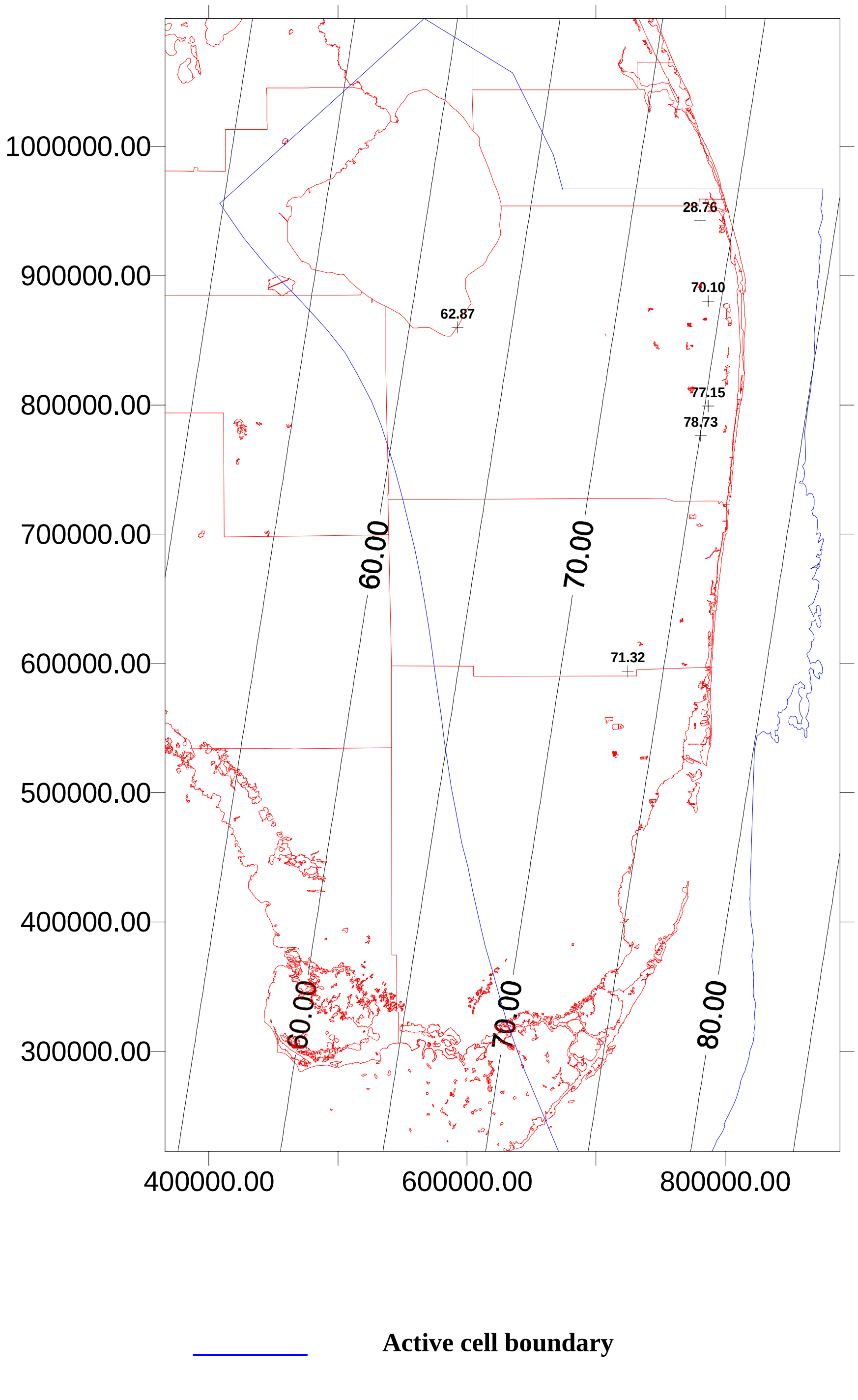


Figure 8. Initial Head Distribution – Layer 7.

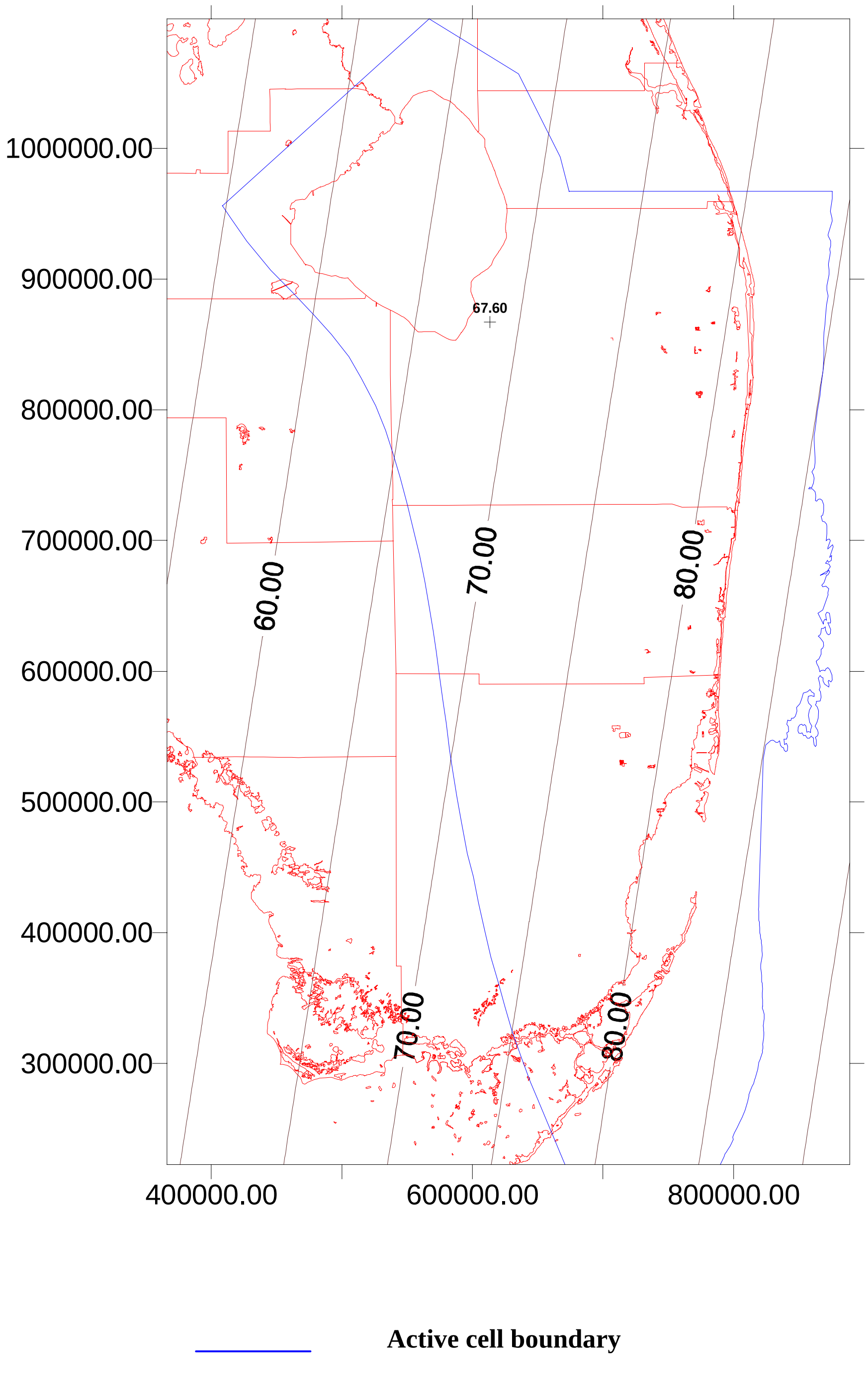


Figure 9. Initial Head Distribution – Layer 8.

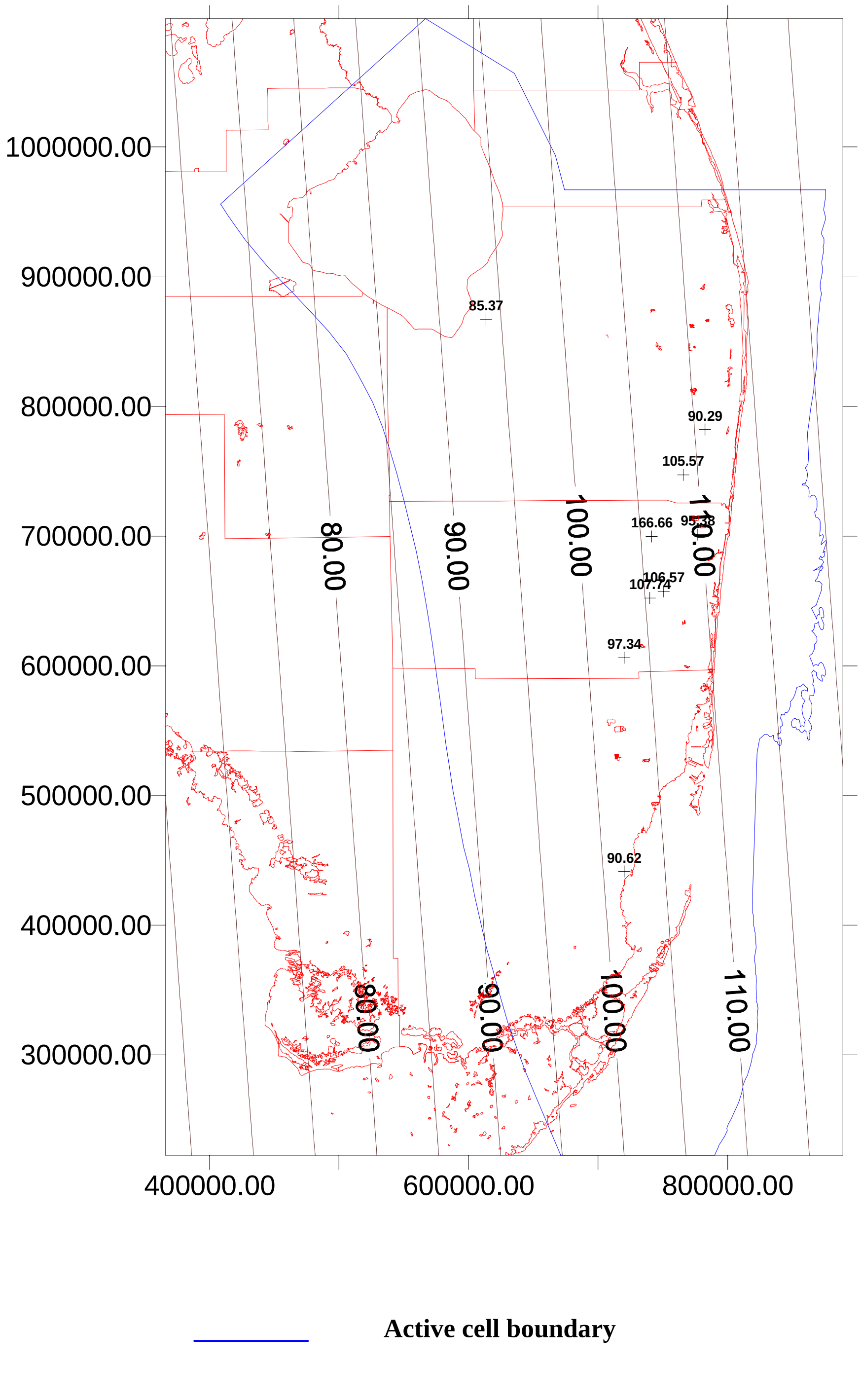


Figure 10. Initial Head Distribution – Layer 9.

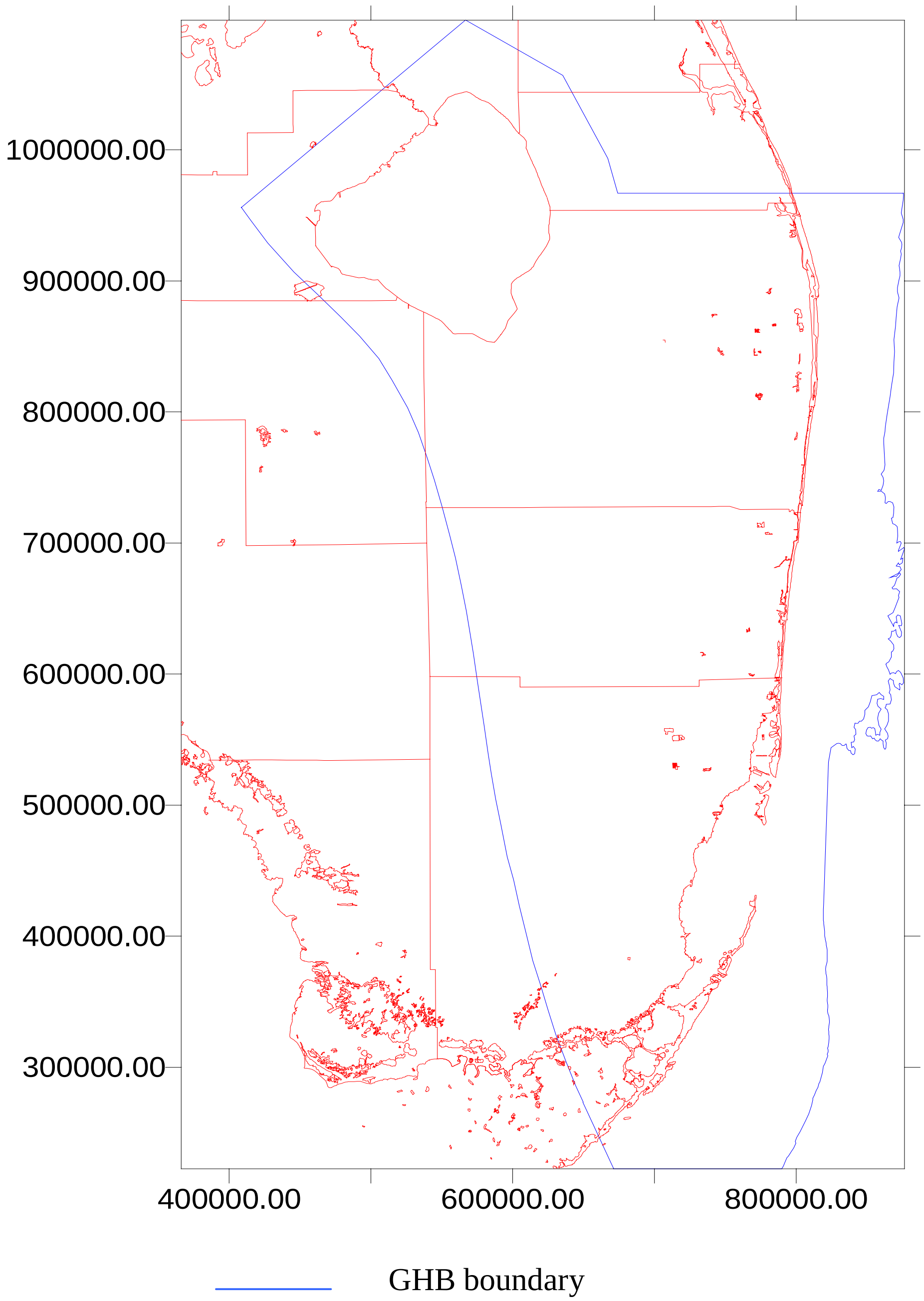


Figure 11. General Head Boundary Delineation.

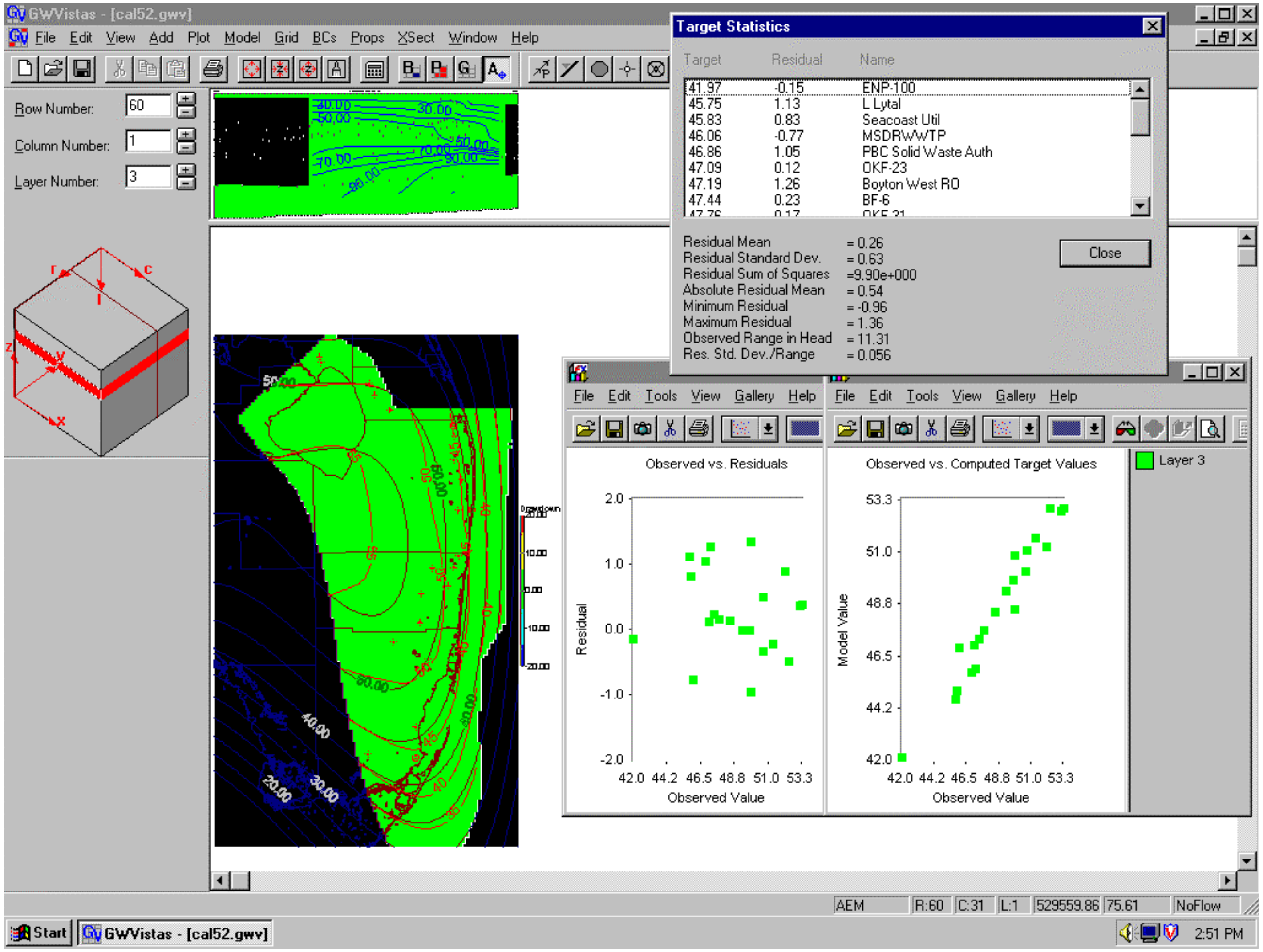


Figure 12. Calibration Statistics for Layer 3.

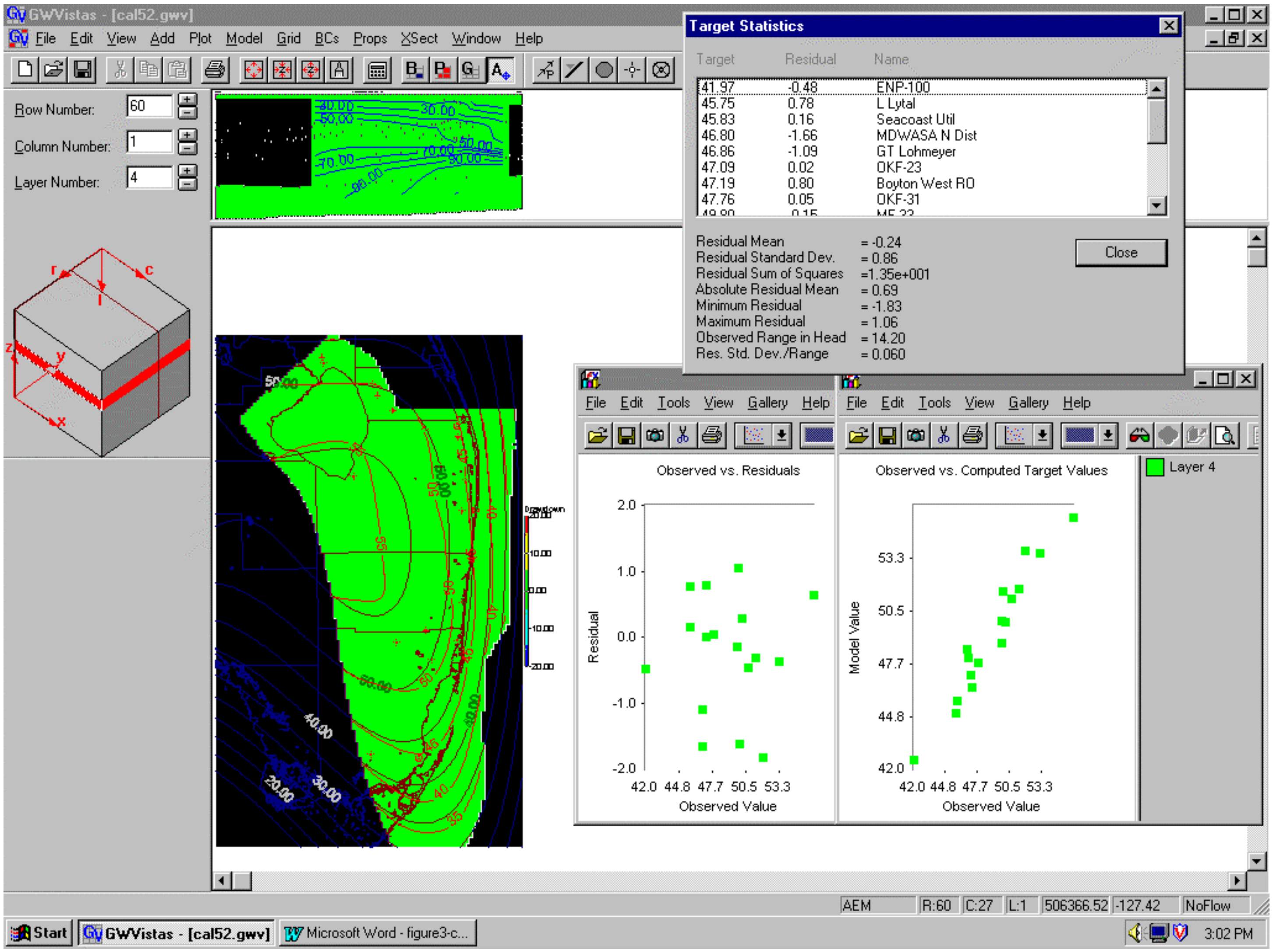


Figure 13. Calibration Statistics for Layer 4.

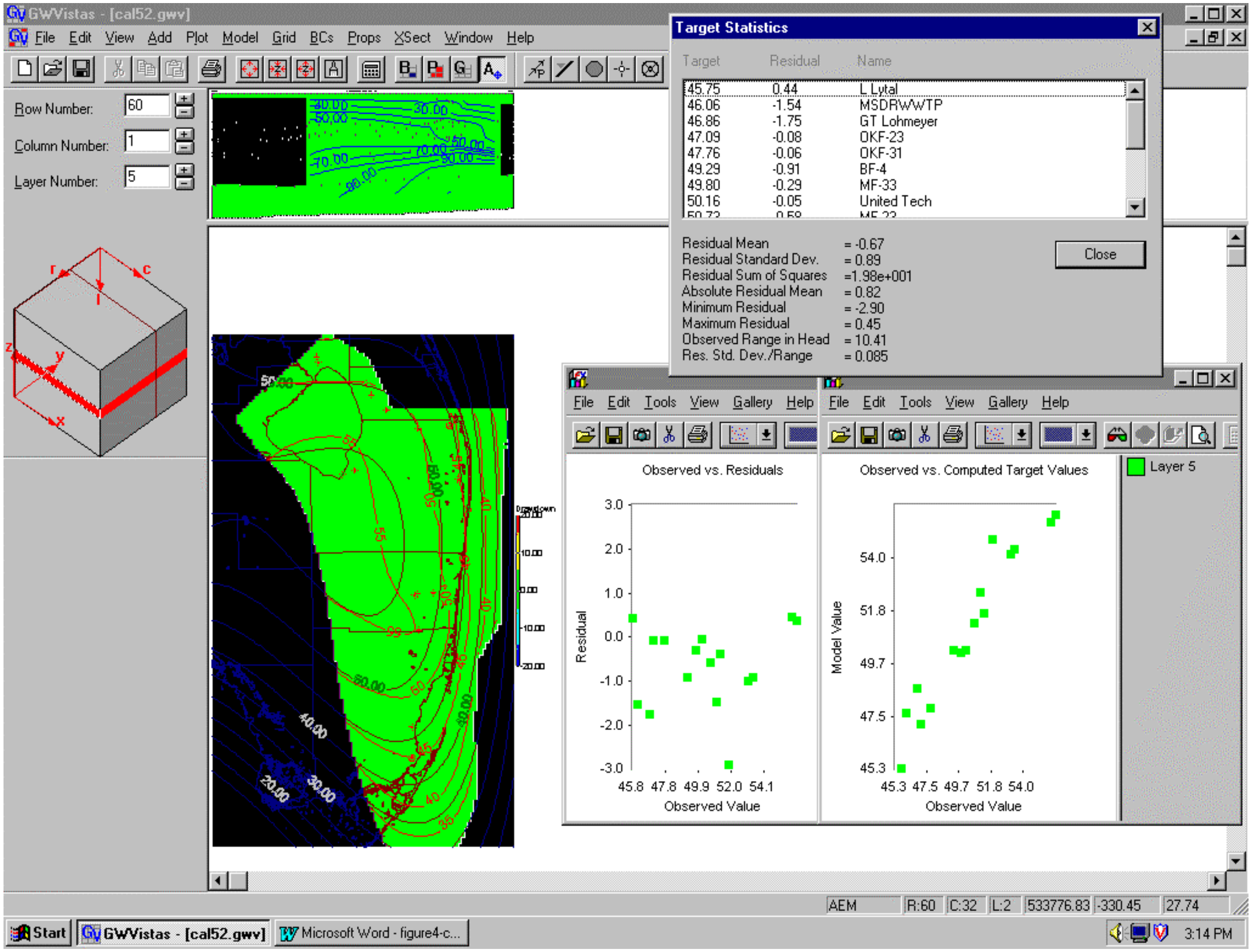


Figure 14. Calibration Statistics for Layer 5.

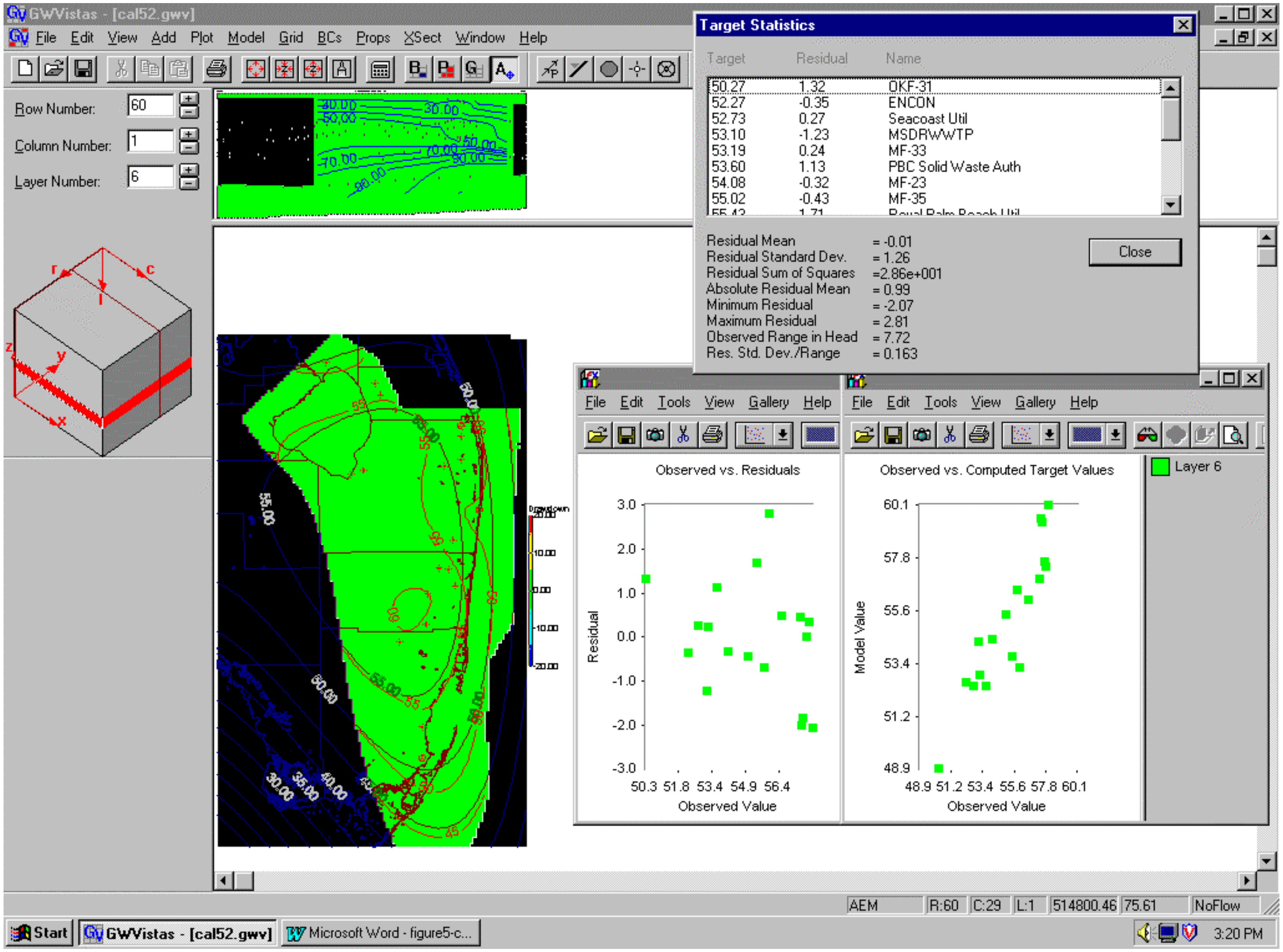


Figure 15. Calibration Statistics for Layer 6.

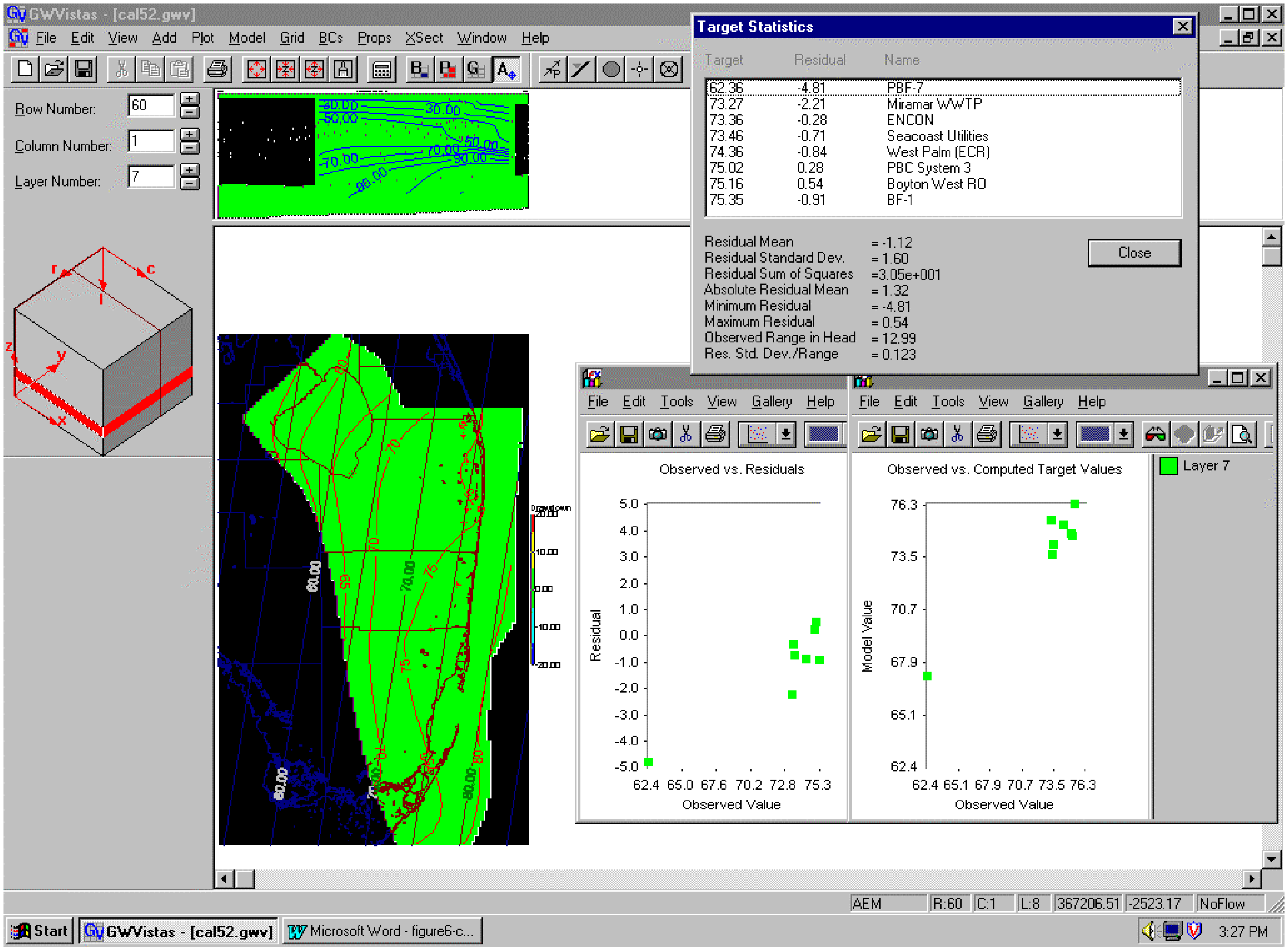


Figure 16. Calibration Statistics for Layer 7.

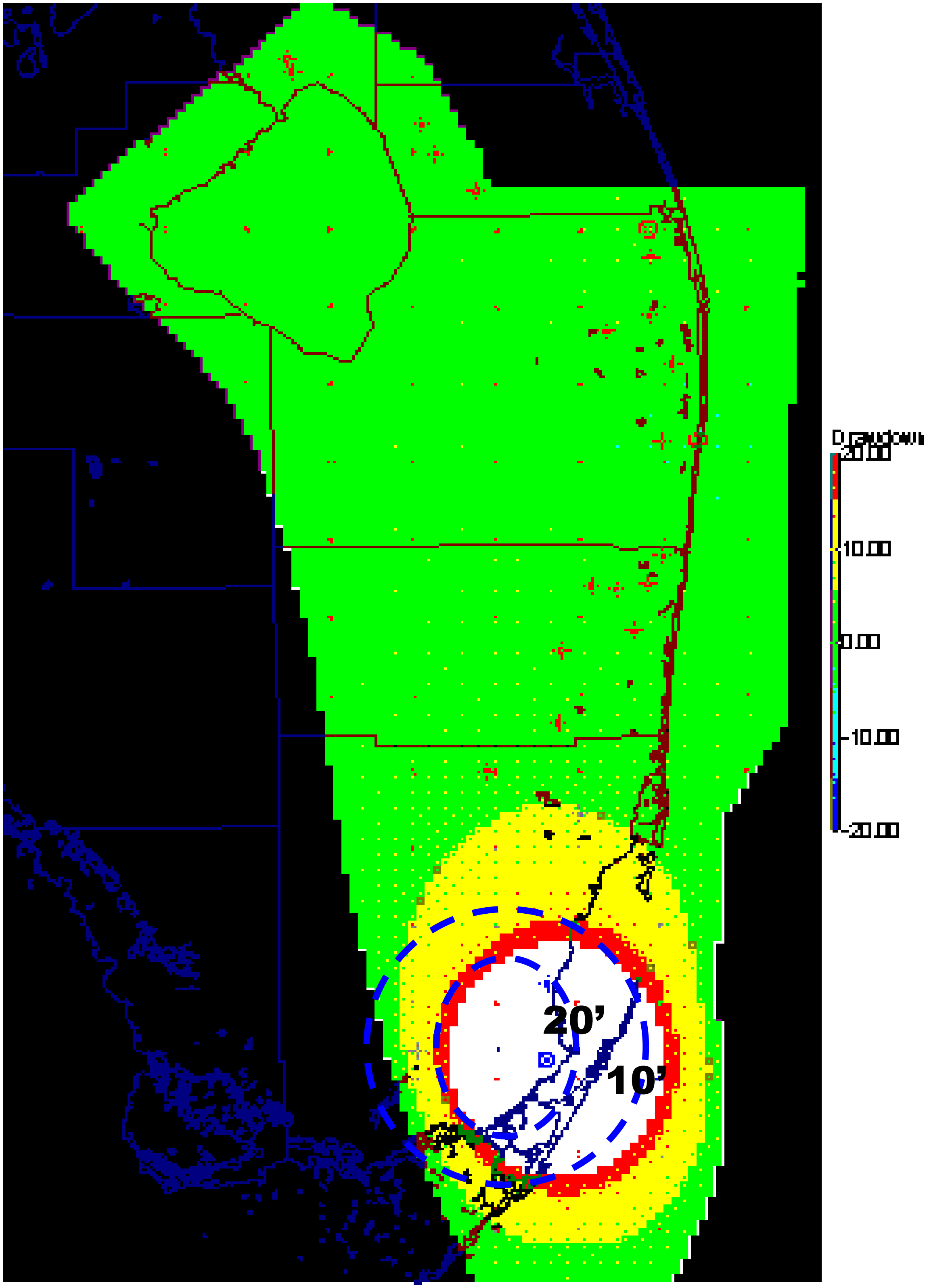


Figure 17. Drawdown Comparison of Analytical (dashed) vs. Model (solid) Predictions at FPL's Turkey Point Site.

TABLES

Table 1. Altitudes Corresponding to Surficial Aquifer and Flow Zone Model Layers.

			SURFICIAL AQUIFER (LAYER 1)	FLOW ZONE #1 (LAYER 3)		FLOW ZONE #2 (LAYER 5)		FLOW ZONE #3 (LAYER 7)		
Site Id.	***X Coord.***	***Y Coord.***	***Bt. Elev.***	***Top Elev.***	***Bt. Elev.***	***Top Elev.***	***Bt. Elev.***	***Top Elev.***	***Bt. Elev.***	***Reference***
Acme Imp Dist	750942	834288	-180	-805	-1080	-1230	-1480	-1830	-2080	CH2MHILL, 1995
City of Boynton Beach - Disposal Well	786754	799208	-183	-783	-983	-1283	-1583	-1733	-1908	CH2MHILL, 1995
Coral Springs Imp Dist	741441	699813	-190	-940	-1290	-1390	-1440	-2090	-2240	CH2MHILL, 1995 [Picks based on Margate well]
City of Margate	757520	697620	-285	-935	-1285	-1385	-1435	-2085	-2235	CH2MHILL, 1995
PBC System 9	765559	747318	-155	-905	-1180	-1380	-1430	-1830	-2080	CH2MHILL, 1995
PBC Southern Regional	777253	783129	-230	-780	-1080	-1455	-1505	-1780	-1980	CH2MHILL, 1995
Century Village @ Pembroke Pines	720247	606265	-195	-995	-1120	-1595	-1745	-2195	-2295	CH2MHILL, 1995
Pratt & Whitney	723170	938799	-125	-850	-925	-1175	-1575	-1975	-2075	CH2MHILL, 1995
QO Chemicals	613544	867176	-160	-635	-810	-1035	-1385	-1835	-2035	CH2MHILL, 1995
Village of Royal Palm Beach	750942	874484	-130	-880	-1055	-1205	-1430	-2180	-2380	CH2MHILL, 1995
Seacoast Utility Authority	779445	925644	-258	-883	-1033	-1283	-1558	-1983	-2108	CH2MHILL, 1995
City of Sunrise	722439	655962	-195	-995	-1345	-1545	-1695	-2270	-2295	CH2MHILL, 1995
City of WPB #6	786754	880331	-185	-985	-1160	-1285	-1535	-1960	-2085	CH2MHILL, 1995
City of Boynton Beach ASR	809410	799938	-345	-795	-1070	-1295	-1595	-1795	-1895	CH2MHILL, 1995
City of Deerfield Beach	791139	721738	-165	-990	-1165	-1340	-1540	-2090	-2240	CH2MHILL, 1995 [Picks partly based on C-13 well]
City of Hollywood	781638	606265	-293	-943	-1093	-1593	-1743	-2193	-2293	CH2MHILL, 1995 [Picks partly based on Pembroke Pines well]
C-13 Floridan Test Well	789677	676426	-364	-989	-1164	-1339	-1539	-2089	-2239	CH2MHILL, 1995 [Picks partly based on Margate well]
USGS Alligator Alley Test Well	548743	675603	-138	-763	-1238	-1563	-1713	-2063	-2263	CH2MHILL, 1995
Miami-Dade Well I-5	720170	441316	-125	-975	-1055	-1355	-1555	-2395	-2515	CH2MHILL, 1977
MF-1	667937	1043387	-125	-650	-800					Brown & Reece, 1979
MF-3	766873	1047651	-175	-750						Brown & Reece, 1979

Table 1 contd. Altitudes corresponding to surficial aquifer and flow zone model layers.

			SURFICIAL AQUIFER (LAYER 1)	FLOW ZONE #1 (LAYER 3)		FLOW ZONE #2 (LAYER 5)		FLOW ZONE #3 (LAYER 7)		
Site Id.	X Coord.	Y Coord.	Bt. Elev.	Top Elev.	Bt. Elev.	Top Elev.	Bt. Elev.	Top Elev.	Bt. Elev.	Reference
MF-6	635484	1027816	-125	-700	-800	-900				Brown & Reece, 1979
MF-10	731133	997245	-100	-600	-800	-900				Brown & Reece, 1979
OKF-2	593433	1166945	-150	-350	-500	-550				Shaw & Trost, 1984
SLF-5	673614	1151256	-100	-475	-600	-675	-900			Brown & Reece, 1979
SLF-9	632614	1131914	-150	-450	-600	-675	-850			Brown & Reece, 1979
SLF-14	639058	1091948	-125	-550	-850	-950	-1250			Brown & Reece, 1979
SLF-20	604517	1127187	-175	-475	-625	-675	-875			Brown & Reece, 1979
SLF-23	672336	1049363	-100	-625	-800	-825				Brown & Reece, 1979
MF-8	715084	1040781	-150	-575	-850					Brown & Reece, 1979
MF-5	743789	1042558	-225	-850						Brown & Reece, 1979
PBF-1	797129	959196	-250	-850	-1025					Shaw & Trost, 1984
GLF-1	524932	1022450	-200	-600	-775					Shaw & Trost, 1984
GLF-2	494213	983064	-200	-625	-750					Shaw & Trost, 1984
HIF-39	454290	1102237	-125	-375	-675	-875	-1025			Shaw & Trost, 1984
OKF-18	496486	1135331	-150	-375	-600	-650	-900			Shaw & Trost, 1984
OKF-19	511261	1132808	-125	-350	-500	-600	-850			Shaw & Trost, 1984
OKF-29	551354	1129709	-50	-375	-550	-650	-850			Shaw & Trost, 1984
Plantation #1	739972	652373	-218	-1043		-1585	-1648	-2180	-2247	CDM, 1987 & 1991a
Plantation #2	750609	657383	-217			-1572	-1642	-2122	-2222	CDM, 1991b
SLF-50	662955	1092340	-105	-625	-745	-815	-935			Wedderburn & Knapp, 1983
USSC ASR Test Well	674453	890741	-185	-935	-1035	-1160	-1460			ViroGroup, 1993
PU-I1 (Sunset Park)	713777	494534	-135	-895	-1075	-1535	-1725	-2495	-2715	Black, Crow & Eidsness, 1970

Table 1 contd. Altitudes corresponding to surficial aquifer and flow zone model layers.

			SURFICIAL AQUIFER (LAYER 1)	FLOW ZONE #1 (LAYER 3)		FLOW ZONE #2 (LAYER 5)		FLOW ZONE #3 (LAYER 7)		
Site Id.	**X Coord.**	**Y Coord.**	**Bt. Elev.**	**Top Elev.**	**Bt. Elev.**	**Top Elev.**	**Bt. Elev.**	**Top Elev.**	**Bt. Elev.**	**Reference**
PU-I2 (Kendale Lakes)	692558	493627	-115	-1055	-1095	-1505	-1735	-2495	-2705	Black, Crow & Eidsness, 1972
G-3061 (Hialeah ASR well)	734185	543807		-1019	-1031					Reese, 1994
NP-100	631054	381242		-965	-1005	-1165	-1328			Meyer, 1971
S-524	636935	465655				-1132	-1192			Meyer, 1971
G-1273	695665	287597		-800	-890					Meyer, 1971
W-2912	500053	882046		-1185	-1295	-1605	-1645	-2045	-2085	Puri & Winston, 1974
W-4661	573250	735652		-905	-935	-1215	-1235			Puri & Winston, 1974
W-445	535188	483855		-910	-930	-1440	-1470	-1920	-2050	Puri & Winston, 1974
Jupiter RO facility (multi-well composite)	778291	944693			-1035	-1315	-1645	-1815		ViroGroup, 1994
Stuart Injection Well IW-2	748598	1038851				-975	-1055			Montgomery Watson, 1997
City of Miramar IW-1	724512	594136	-183	-1063	-1133	-1632	-1731	-1913	-1998	Montgomery Watson, 1996
City of WPB ASR	804703	864431	-355	-960	-1185					CH2MHill, 1998b
City of Sunrise ASR	742533	667332	-182	-1102	-1262					Montgomery Watson, 1998
City of Delray Beach ASR	741876	782028		-1006	-1190					CH2MHill, 1998a
West Wellfield ASR	672876	496977	-166	-831	-1241					CH2MHill, 1997b
PBC System 3 Multipurpose Floridan Well	782494	782181	-320	-1040						Kimley-Horn & Assoc., 1998
BCOES ASR facility	792605	713184	-362	-977	-1182					CH2MHill, 1997a
Indiantown Cogeneration Project (IPW-1)	657324	985586	-133	-675	-695	-745	-775	-1435	-1475	Bechtel Corp., 1991 & 1994
SFWMD Okeechobee ASR Demo. Proj.	570202	1053544	-125					-1283	-1605	CH2MHill, 1989a
DBF R0-1/BF-6	786910	720819	-412	-947	-1115					Lukasiewicz, SFWMD (unpublished data)
BF-3/BF-1	769399	669411	-395	-995	-1195	-1495	-1595	-2095	-2145	Lukasiewicz, SFWMD (unpublished data)

Table 1 contd. Altitudes corresponding to surficial aquifer and flow zone model layers.

			SURFICIAL AQUIFER (LAYER 1)	FLOW ZONE #1 (LAYER 3)		FLOW ZONE #2 (LAYER 5)		FLOW ZONE #3 (LAYER 7)		
Site Id.	**X Coord.**	**Y Coord.**	**Bt. Elev.**	**Top Elev.**	**Bt. Elev.**	**Top Elev.**	**Bt. Elev.**	**Top Elev.**	**Bt. Elev.**	**Reference**
DF1	674672	573207	-195	-1090	-1189	-1690	-1775	-2560	-2635	Lukasiewicz, SFWMD (unpublished data)
PBF-3	792908	852229	-295	-1035	-1237	-1345	-1495	-2325	-2475	Lukasiewicz, SFWMD (unpublished data)
Loxahatchee R. ENCON	780324	942215	-366			-1366	-1686	-2048	-2093	Geraghty & Miller, 1994
N. Port St. Lucie IW	710753	1092359	-135	-585				-2085	-2385	CH2MHill, 1987
N. Martin Ct. IW (DeBartolo Corp. site)	737470	1057769	-335					-1690	-1955	Geraghty & Miller, 1988
FPL Turkey Point (Obs. Well A)	695303	369971	-97	-1097	-1250					Dames & Moore, 1975
Broward N. District Regional WWTP (IW-4)	776937	701266	-435					-1985	-2135	Geraghty & Miller, 1991a,b
Lohmeyer Plant (Ft. Lauderdale)	787166	642468								Geraghty & Miller, 1984
Deerfield Floridan Test/Production Well	786999	721123		-950	-1118					Camp, Dresser & McKee, 1993

Table 2. Geometric Means (GM) of Horizontal (K) and Vertical (K') Hydraulic Conductivity Values Corresponding to Model Layers.

SITE ID.	X COORD.	Y COORD.	K (ft/d)	K'(ft/d)	REFERENCES
LAYER 2					
City of Deerfield Beach	791139	721738		2	CH2M Hill, 1995
City of Hollywood	781638	606265		0.04	CH2M Hill, 1995
City of WPB ASR	804703	864431	0.5	0.4	CH2M Hill, 1998b
Indiantown Cogeneration Project (IPW-1)	657324	985586		0.005	Bechtel Corp., 1991 & 1994
DBF R0-1/BF-6	786910	720819		0.0001	SFWMD (unpublished data)
FPL Turkey Point (Obs. Well A)	695303	369971		0.002	Dames & Moore, 1975
Deerfield Floridan Test/Production Well	786999	721123	***GM = 0.5***	***GM = 0.02***	Camp, Dresser & McKee, 1993
LAYER 3					
Century Village @ Pembroke Pines	720247	606265	118		Geraghty & Miller, 1995
City of Boynton Beach ASR	809410	799938	90		CH2M Hill, 1995
City of Deerfield Beach	791139	721738	140		CH2M Hill, 1995
City of Hollywood	781638	606265	139		CH2M Hill, 1995
C-13 Floridan Test Well	789677	676426	680		CH2M Hill, 1995
MF-6	635484	1027816	169		Brown & Reece, 1979
OKF-2	593433	1166945	576		Shaw & Trost, 1984
SLF-9	632614	1131914	1026		Brown, 1980
SLF-20	604517	1127187	72		Brown, 1980
SLF-50	662955	1092340	94	8	Wedderburn & Knapp, 1983
City of WPB ASR	804703	864431	566		CH2M Hill, 1998b
City of Sunrise ASR	742533	667332	30		Montgomery Watson, 1998
West Wellfield ASR	672876	496977	30		CH2M Hill, 1997b
BCOES ASR facility	792605	713184	1320		CH2M Hill, 1997a
Indiantown Cogeneration Project (IPW-1)	657324	985586	55		Bechtel Corp., 1991 & 1994

Table 2 contd. Geometric Means (GM) of Horizontal (K) and Vertical (K') Hydraulic Conductivity Values Corresponding to Model Layers.

SITE ID.	X COORD.	Y COORD.	K (ft/d)	K'(ft/d)	REFERENCES
LAYER 3 (contd.)					
DBF R0-1/BF-6	786910	720819	144		SFWMD (unpublished data)
BF-3/BF-1	769399	669411	679		SFWMD (unpublished data)
DF1	674672	573207	181		SFWMD (unpublished data)
PBF-3	792908	852229	171		SFWMD (unpublished data)
FPL Turkey Point (Obs. Well A)	695303	369971	80		Dames & Moore, 1975
Deerfield Floridan Test/Production Well	786999	721123	144		Camp, Dresser & McKee, 1993
			GM = 175	***GM = 8***	
LAYER 4					
City of WPB ASR	804703	864431	0.0005		CH2M Hill, 1998b
City of Sunrise ASR	742533	667332	0.4		Montgomery Watson, 1998
Jupiter RO facility	778291	944693		0.003	ViroGroup, 1994
City of WPB ASR	804703	864431		0.0007	CH2M Hill, 1998
BF-3/BF-1	769399	669411		0.13	SFWMD (unpublished data)
			GM = 0.01	***GM = 0.007***	
LAYER 5					
Century Village @ Pembroke Pines	720247	606265	0.2		Geraghty & Miller, 1995
C-13 Floridan Test Well	789677	676426	30		CH2M Hill, 1995
MF-6	635484	1027816	183		Brown, 1980
SLF-9	632614	1131914	0.001		Brown, 1980
SLF-20	604517	1127187	24		Brown, 1980
Plantation #1	739972	652373	40		CDM, 1987 & 1991a
Plantation #2	750609	657383	124		CDM, 1991b
SLF-50	662955	1092340	25		Wedderburn & Knapp, 1983
Jupiter RO facility (multi well composite)	778291	944693	249		ViroGroup, 1994
City of Miramar IW-1	724512	594136	16		Montgomery Watson, 1996
Indiantown Cogeneration Project (IPW-1)	657324	985586	55		Bechtel Corp., 1991 & 1994
BF-3/BF-1	769399	669411	103		SFWMD (unpublished data)
DF1	674672	573207	35		SFWMD (unpublished data)
PBF-3	792908	852229	1667		SFWMD (unpublished data)
			GM = 21		

Table 2 contd. Geometric Means (GM) of Horizontal (K) and Vertical (K') Hydraulic Conductivity Values Corresponding to Model Layers.

SITE ID.	X COORD.	Y COORD.	K (ft/d)	K'(ft/d)	REFERENCES
LAYER 6					
Acme Imp Dist	750942	834288	0.4		CH2M Hill, 1995
Coral Springs Imp Dist	741441	699813	0.04	0.16	Geraghty and Miller, 1986
C-13 Floridan Test Well	789677	676426	0.4		CH2M Hill, 1995
Miami-Dade Well I-5	720170	441316	3		CH2M Hill, 1977; Hydrologic Assoc., 1994
Plantation #1	739972	652373	17	0.1	CDM, 1987 & 1991a
Plantation #2	750609	657383	37	3	CDM, 1991b
City of Miramar IW-1	724512	594136	21	0.09	Montgomery Watson, 1996
BF-3/BF-1	769399	669411	5		SFWMD (unpublished data)
Indiantown Cogeneration Project (IPW-1)	657324	985586		0.96	Bechtel Corp., 1991 & 1994
SFWMD Okeechobee ASR Demo. Proj.	570202	1053544		0.4	CH2M Hill, 1989
Broward N. District Regional WWTP (IW-4)	776937	701266		0.4	Geraghty & Miller, 1991a,b
			GM = 2	***GM = 0.35***	
LAYER 7					
Acme Imp Dist	750942	834288	14		CH2M Hill, 1995
Coral Springs Imp Dist	741441	699813	0.03	0.22	Geraghty & Miller, 1986
PBC Southern Regional	777253	783129	116		CH2M Hill, 1995
C-13 Floridan Test Well	789677	676426	210		CH2M Hill, 1995
Plantation #2	750609	657383	94		CDM, 1991b
City of Miramar IW-1	724512	594136	20		Montgomery Watson, 1996
Indiantown Cogeneration Project (IPW-1)	657324	985586	2055		Bechtel Corp., 1991 & 1994
SFWMD Okeechobee ASR Demo. Proj.	570202	1053544	1470		CH2M Hill, 1989a
BF-3/BF-1	769399	669411	205		SFWMD (unpublished data)
DF1	674672	573207	40		SFWMD (unpublished data)
PBF-3	792908	852229	7		SFWMD (unpublished data)
Loxahatchee R. ENCON	780324	942215	1313		Geraghty & Miller, 1994
N. Martin Ct. IW (DeBartolo Corp. site)	737470	1057769	32		Geraghty & Miller, 1988
			GM = 60	***GM = 0.22***	
LAYER 8					
Acme Imp Dist	750942	834288	7		CH2M HIll, 1995
Coral Springs Imp Dist	741441	699813	0.05		CH2M Hill, 1995; Geraghty & Miller, 1986
Century Village @ Pembroke Pines	720247	606265	2		Geraghty & Miller, 1995
Village of Royal Palm Beach	750942	874484	0.005	0.001	CH2MHILL, 1995
Seacoast Utility Authority	779445	925644	0.003	0.002	CH2M Hill, 1989b
Plantation #1	739972	652373	5	0.07	CDM, 1987 & 1991a

Table 2 contd. Geometric Means (GM) of Horizontal (K) and Vertical (K') Hydraulic Conductivity Values Corresponding to Model Layers.

SITE ID.	X COORD.	Y COORD.	K (ft/d)	K'(ft/d)	REFERENCES
LAYER 8 (contd.)					
Plantation #2	750609	657383	4	0.3	CDM, 1991b
City of Miramar IW-1	724512	594136	0.9	0.0009	Montgomery Watson, 1996
N. Port St. Lucie IW	710753	1092359	0.00013	0.000051	CH2MHill, 1987
N. Martin Ct. IW (DeBartolo Corp. site)	737470	1057769	4	0.00041	Geraghty & Miller, 1988
Broward N. District Regional WWTP (IW-4)	776937	701266	1		Geraghty & Miller, 1991a,b
Coral Springs Imp Dist	741441	699813		0.004	Geraghty & Miller, 1986
PBC System 9	765559	747318		0.002	CH2M Hill, 1986
PBC System 3 Multipurpose Floridan Well	782494	782181		0.02	Kimley-Horn, 1998; Geraghty & Miller, 1987
Lohmeyer Plant (Ft. Lauderdale)	787166	642468		0.1	Geraghty & Miller, 1984
			GM = 0.2	***GM = 0.004***	
LAYER 9					
Coral Springs Imp Dist	741441	699813	1000		Geraghty & Miller, 1986
Century Village @ Pembroke Pines	720247	606265	733		Geraghty & Miller, 1995
Miami-Dade Well I-5	720170	441316	58565		Singh et al., 1983
Plantation #2	750609	657383	133	3	CDM, 1991b
PBC System 3 Multipurpose Floridan Well	782494	782181	607		Kimley-Horn, 1998; Geraghty & Miller, 1987
N. Martin Ct. IW (DeBartolo Corp. site)	737470	1057769	804		Geraghty & Miller, 1988
Lohmeyer Plant (Ft. Lauderdale)	787166	642468	19647		Geraghty & Miller, 1984
			GM = 1771	***GM = 3***	

Table 3. Boynton Beach ASR Injection and Recovery Data, 1995-1997.

Date	Days	Duration Days Injected	Duration Days Recovery	Injected Rate (MG)	Total Injected (MG)	Avg. Daily Injected	Recovery Rate (MG)	Total Withdrawn (MG)	Avg. Daily Withdrawn (MG)
Jan-95	31		23		0.000	0.000	30.007	690.161	22.263
Feb-95	28		8		0.000	0.000	6.970	55.760	1.991
Mar-95	31				0.000	0.000		0.000	0.000
Apr-95	30	11		9.180	100.980	3.366		0.000	0.000
May-95	31	31		30.400	942.400	30.400		0.000	0.000
Jun-95	30	5	25	3.280	16.400	0.547	18.700	467.500	15.583
Jul-95	31		3		0.000	0.000	1.890	5.670	0.183
Aug-95	31				0.000	0.000		0.000	0.000
Sep-95	30	4		4.320	17.280	0.576		0.000	0.000
Oct-95	31	31		35.800	1109.800	35.800		0.000	0.000
Nov-95	30		13		0.000	0.000	12.300	159.900	5.330
Dec-95	31		20		0.000	0.000	21.200	424.000	13.677
Jan-96	31	14		12.500	175.000	5.645		0.000	0.000
Feb-96	29	29		26.250	761.250	26.250		0.000	0.000
Mar-96	31	4		3.000	12.000	0.387		0.000	0.000
Apr-96	30		7		0.000	0.000	8.866	62.062	2.069
May-96	31		22		0.000	0.000	26.751	588.522	18.985
Jun-96	30	27		31.070	838.890	27.963		0.000	0.000
Jul-96	31	8		10.220	81.760	2.637		0.000	0.000
Aug-96	31				0.000	0.000		0.000	0.000
Sep-96	30				0.000	0.000		0.000	0.000
Oct-96	31				0.000	0.000		0.000	0.000
Nov-96	30				0.000	0.000		0.000	0.000
Dec-96	31		28		0.000	0.000	37.650	1054.200	34.006
Jan-97	31	29		26.900	780.100	25.165		0.000	0.000
Feb-97	28	14		13.690	191.660	6.845		0.000	0.000
Mar-97	31				0.000	0.000		0.000	0.000
Apr-97	30				0.000	0.000		0.000	0.000
May-97	31		25		0.000	0.000	21.110	527.750	17.024
Jun-97	30	11	16	14.470	159.170	5.306	11.070	177.120	5.904
Jul-97	31	24		28.040	672.960	21.708		0.000	0.000
Aug-97	31				0.000	0.000		0.000	0.000
Sep-97	30				0.000	0.000		0.000	0.000
Oct-97	31				0.000	0.000		0.000	0.000
Nov-97	30				0.000	0.000		0.000	0.000
Dec-97	31				0.000	0.000		0.000	0.000
Overall Avg. Injection Rate (MGD):						**5.350**			
Overall Avg. Withdrawal Rate (MGD):									**3.806**
1 well (ASR-1)									
(x,y): 809410, 799938									
Row,Col: R57,C84									
Depth Interval: 804-909 feet									
Zone: UFZ1 - layer 3									

Table 4. Jupiter RO Plant Water Use Data, 1995 – 1997.

Date	Days	Total Treated (MG)	Assumed Treatment Efficiency (%)	Raw Water (MG)	Avg. Daily (MG)
Jan-95	31	39.006	0.750	52.008	1.678
Feb-95	28	20.903	0.750	27.871	0.995
Mar-95	31	63.097	0.750	84.129	2.714
Apr-95	30	79.253	0.750	105.671	3.522
May-95	31	98.242	0.750	130.989	4.225
Jun-95	30	61.142	0.750	81.523	2.717
Jul-95	31	41.932	0.750	55.909	1.804
Aug-95	31	37.640	0.750	50.187	1.619
Sep-95	30	79.033	0.750	105.377	3.513
Oct-95	31	79.480	0.750	105.973	3.418
Nov-95	30	35.771	0.750	47.695	1.590
Dec-95	31	83.368	0.750	111.157	3.586
Jan-96	31	52.346	0.750	69.795	2.251
Feb-96	29	81.632	0.750	108.843	3.753
Mar-96	31	59.280	0.750	79.040	2.550
Apr-96	30	91.304	0.750	121.739	4.058
May-96	31	75.609	0.750	100.812	3.252
Jun-96	30	54.848	0.750	73.131	2.438
Jul-96	31	79.805	0.750	106.407	3.432
Aug-96	31	75.553	0.750	100.737	3.250
Sep-96	30	74.041	0.750	98.721	3.291
Oct-96	31	44.731	0.750	59.641	1.924
Nov-96	30	63.636	0.750	84.848	2.828
Dec-96	31	85.954	0.750	114.605	3.697
Jan-97	31	76.143	0.750	101.524	3.275
Feb-97	28	67.350	0.750	89.800	3.207
Mar-97	31	83.518	0.750	111.357	3.592
Apr-97	30	68.718	0.750	91.624	3.054
May-97	31	73.197	0.750	97.596	3.148
Jun-97	30	64.043	0.750	85.391	2.846
Jul-97	31	88.974	0.750	118.632	3.827
Aug-97	31	58.753	0.750	78.337	2.527
Sep-97	30	49.076	0.750	65.435	2.181
Oct-97	31	(missing record)			
Nov-97	30	81.002	0.750	108.003	3.600
Dec-97	31	66.587	0.750	88.783	2.864
Overall Avg. Flow Rate (MGD):					**2.921**
3 well composite (RO-5,RO-6,RO-7)					
(x,y): 778291,944693					
Row,Col: R30,C79					
Depth Interval: 1330-1665 feet					
Zone: UFZ2 - layer 5					

Table 5. Layer 3 Calibration Targets.

Name	X-coord	Y-coord	Observed	Computed	Residual
Boyton West RO	786754	799208	47.19	45.93	1.26
Broward Ctny N Reg	777664	701472	48.52	48.38	0.14
Coral Springs Imp Dist	741441	699813	52.14	51.25	0.89
Margate WWTP	757520	697620	50.67	50.16	0.51
MSDRWWTP	713554	427801	46.06	46.83	-0.77
PBC Solid Waste Auth	778716	885252	46.86	45.81	1.05
City of Pembroke Pines	720247	606265	52.42	52.90	-0.48
Royal Palm Beach Util	750942	874484	49.86	48.50	1.36
City of Sunrise	722439	655962	53.15	52.79	0.36
Seacoast Util	779445	925644	45.83	45.00	0.83
BF-4	768944	669409	49.29	49.30	-0.01
BF-6	786910	720819	47.44	47.21	0.23
DF-4	674673	573208	53.28	52.89	0.39
G-3061	734186	543807	49.91	50.87	-0.96
ENP-100	630962	381343	41.97	42.12	-0.15
L Lytal	793092	851927	45.75	44.62	1.13
MF-35	668237	970484	51.36	51.59	-0.23
MF-23	642188	996134	50.73	51.06	-0.33
MF-33	633265	1015996	49.80	49.81	-0.01
OKF-31	550550	1051958	47.76	47.59	0.17
OKF-23	547290	1061446	47.09	46.97	0.12

Residual Mean	0.26
Res. Std. Dev.	0.63
Sum of Squares	9.90
Abs. Res. Mean	0.54
Min. Residual	-0.96
Max. Residual	1.36
Head Range	11.31
Head Range/Std	0.06

Table 6. Layer 4 Calibration Targets.

Name	X-coord	Y-coord	Observed	Computed	Residual
Belle Glade	601306	858391	56.17	55.53	0.64
Boyton West RO	786754	799208	47.19	46.39	0.80
GT Lohmeyer	787166	642468	46.86	47.95	-1.09
MDWASA N Dist	778383	576782	46.80	48.46	-1.66
Miramar WWTP	724512	594136	51.89	53.72	-1.83
Royal Palm Beach Util	750942	874484	49.86	48.80	1.06
Seacoast Util	779445	925644	45.83	45.67	0.16
United Tech	723170	938799	50.16	49.87	0.29
DF-4	674673	573208	53.28	53.64	-0.36
G-3061	734186	543807	49.91	51.53	-1.62
ENP-100	630962	381343	41.97	42.45	-0.48
L Lytal	793092	851927	45.75	44.97	0.78
MF-35	668237	970484	51.36	51.67	-0.31
MF-23	642188	996134	50.73	51.18	-0.45
MF-33	633265	1015996	49.80	49.95	-0.15
OKF-31	550550	1051958	47.76	47.71	0.05
OKF-23	547290	1061446	47.09	47.07	0.02

Residual Mean	-0.24
Res. Std. Dev.	0.86
Sum of Squares	13.53
Abs. Res. Mean	0.69
Min. Residual	-1.83
Max. Residual	1.06
Head Range	14.20
Head Range/Std	0.06

Table 7. Layer 5 Calibration Targets.

Name	X-coord	Y-coord	Observed	Computed	Residual
GT Lohmeyer	787166	642468	46.86	48.61	-1.75
Miramar WWTP	724512	594136	51.89	54.79	-2.90
MSDRWWTP	713554	427801	46.06	47.60	-1.54
Plantation Reg	749697	657681	51.08	52.56	-1.48
QO Chemicals Inc	613544	867176	55.90	55.45	0.45
Sawgrass WWTP	717366	653364	53.43	54.35	-0.92
City of Sunrise	722439	655962	53.15	54.14	-0.99
United Tech	723170	938799	50.16	50.21	-0.05
PBF-7	592777	859986	56.16	55.80	0.36
BF-4	768944	669409	49.29	50.20	-0.91
L Lytal	793092	851927	45.75	45.31	0.44
MF-35	668237	970484	51.36	51.75	-0.39
MF-23	642188	996134	50.73	51.31	-0.58
MF-33	633265	1015996	49.80	50.09	-0.29
OKF-31	550550	1051958	47.76	47.82	-0.06
OKF-23	547290	1061446	47.09	47.17	-0.08

Residual Mean	-0.67
Res. Std. Dev.	0.89
Sum of Squares	19.79
Abs. Res. Mean	0.82
Min. Residual	-2.90
Max. Residual	0.45
Head Range	10.41
Head Range/Std	0.09

Table 8. Layer 6 Calibration Targets.

Name	X-coord	Y-coord	Observed	Computed	Residual
Coral Springs Imp Dist	741441	699813	57.43	56.97	0.46
ENCON	780594	942520	52.27	52.62	-0.35
Margate WWTP	757520	697620	56.59	56.09	0.50
Miramar RO	719353	603498	57.52	59.53	-2.01
MSDRWWTP	713554	427801	53.10	54.33	-1.23
PBC Solid Waste Auth	778716	885252	53.60	52.47	1.13
PBC System 9	765559	747318	56.03	53.22	2.81
QO Chemicals Inc	613544	867176	57.82	57.47	0.35
Royal Palm Beach Util	750942	874484	55.43	53.72	1.71
City of Sunrise	722439	655962	57.99	60.06	-2.07
Seacoast Util	779445	925644	52.73	52.46	0.27
PBF-7	592777	859986	57.71	57.69	0.02
BF-4	768944	669409	55.80	56.49	-0.69
DF-5	674673	573208	57.54	59.36	-1.82
MF-35	668237	970484	55.02	55.45	-0.43
MF-23	642188	996134	54.08	54.40	-0.32
MF-33	633265	1015996	53.19	52.95	0.24
OKF-31	550550	1051958	50.27	48.95	1.32

Residual Mean	-0.01
Res. Std. Dev.	1.26
Sum of Squares	28.63
Abs. Res. Mean	0.99
Min. Residual	-2.07
Max. Residual	2.81
Head Range	7.72
Head Range/Std	0.16

Table 9. Layer 7 Calibration Targets.

Name	X_coord	Y_coord	Observed	Computed	Residual
Boyton West RO	786754	799208	75.16	74.62	0.54
ENCON	780594	942520	73.36	73.64	-0.28
Miramar WWTP	724512	594136	73.27	75.48	-2.21
PBC System 3	780988	776416	75.02	74.74	0.28
Seacoast Utilities	779445	925644	73.46	74.17	-0.71
West Palm (ECR)	786754	880331	74.36	75.20	-0.84
PBF-7	592777	859986	62.36	67.17	-4.81
BF-1	769399	669412	75.35	76.26	-0.91

Residual Mean	-1.12
Res. Std. Dev.	1.60
Sum of Squares	30.46
Abs. Res. Mean	1.32
Min. Residual	-4.81
Max. Residual	0.54
Head Range	12.99
Head Range/Std	0.12

Table 10. Hydraulic Conductivity Comparison (Initial vs. Calibrated).

	Initial Parameters				Calibrated Parameters			
Layer	Kx	Ky	Kz	Anisotropy Ratio (Kx/Kz)	Kx	Ky	Kz	Anisotropy Ratio (Kx/Kz)
2	5.00E-01	5.00E-01	2.00E-02	2.50E+01	5.00E-01	5.00E-01	1.00E-05	5.00E+04
3	1.75E+02	1.75E+02	8.00E+00	2.19E+01	1.75E+02	1.75E+02	8.00E+00	2.19E+01
4	1.00E-02	1.00E-02	7.00E-03	1.43E+00	9.00E-02	9.00E-02	7.00E-03	1.29E+01
5	2.10E+01	2.10E+01	1.10E+00	1.91E+01	7.50E+01	7.50E+01	9.00E+00	8.33E+00
6	2.00E+00	2.00E+00	3.50E-01	5.71E+00	9.00E+00	9.00E+00	2.20E-03	4.09E+03
7	6.00E+01	6.00E+01	2.20E-01	2.73E+02	9.90E+01	9.90E+01	2.20E-04	4.50E+05
8	2.00E-01	2.00E-01	4.00E-03	5.00E+01	9.00E-01	9.00E-01	1.70E-03	5.29E+02

Table 11. Mass Balance By Layer.

Layer 1 Mass Balance

	Inflow	Outflow	% Total Inflow	% Total Outflow
Top	0.00	0.00	0.00	0.00
Bottom	131812.25	792.03	99.40	0.60
CH	792.03	131812.25	0.60	99.40
Total	132604.28	132604.28		

Layer 2 Mass Balance

	Inflow	Outflow	% Total Inflow	% Total Outflow
Top	792.03	131812.25	0.51	85.10
Bottom	133397.24	0.00	86.13	0.00
GHB	20693.99	23071.24	13.36	14.90
Total	154883.26	154883.49		

Layer 3 Mass Balance

	Inflow	Outflow	% Total Inflow	% Total Outflow
Top	0.00	133397.24	0.00	2.90
Bottom	4438125.95	3690.30	96.65	0.08
GHB	153966.16	4454999.60	3.35	97.01
Total	4592092.11	4592087.14		

Layer 4 Mass Balance

	Inflow	Outflow	% Total Inflow	% Total Outflow
Top	3690.30	4438125.95	0.08	98.41
Bottom	4505029.90	2695.89	99.90	0.06
GHB	982.76	68886.13	0.02	1.53
Total	4509702.96	4509707.97		

Layer 5 Mass Balance

	Inflow	Outflow	% Total Inflow	% Total Outflow
Top	2695.89	4505029.90	0.03	49.23
Bottom	9135384.56	9307.26	99.84	0.10
GHB	12365.72	4636108.38	0.14	50.67
Total	9150446.17	9150445.54		

Layer 6 Mass Balance

	Inflow	Outflow	% Total Inflow	% Total Outflow
Top	9307.26	9135384.56	0.09	91.48
Bottom	9944819.57	6441.22	99.59	0.06
GHB	31665.79	843966.07	0.32	8.45
Total	9985792.62	9985791.85		

Layer 7 Mass Balance

	Inflow	Outflow	% Total Inflow	% Total Outflow
Top	6441.22	9944819.57	0.06	85.90
Bottom	10389471.78	0.00	89.74	0.00
GHB	1181884.97	1632978.04	10.21	14.10
Total	11577797.97	11577797.61		

Layer 8 Mass Balance

	Inflow	Outflow	% Total Inflow	% Total Outflow
Top	0.00	10389471.78	0.00	97.73
Bottom	10411792.24	0.00	97.94	0.00
GHB	219346.64	241667.25	2.06	2.27
Total	10631138.88	10631139.03		

Layer 9 Mass Balance

	Inflow	Outflow	% Total Inflow	% Total Outflow
Top	0.00	10411792.24	0.00	100.00
Bottom	0.00	0.00	0.00	0.00
CH	10411792.24	0.00	100.00	0.00
Total	10411792.24	10411792.24		

Table 12. Estimated Inflow Rates to the Upper Floridan Aquifer.

Estimated Upward Flow Rate to the Upper Floridan Aquifer

Model Active Cells = 91822
Total Active Area = (91822 x 5280 x 5280) = 2.56e+012
Upward Flow = (9135385 / 2.56e+12) = 3.57e-06 ft/day (1.56e-02 in/yr)

Estimated Inflow Rates to Layer 3

Model Active Cells = 91822
Total Active Area = (91822 x 5280 x 5280) = 2.56e+012
Bottom Inflow = (4438126 / 2.56e+12) = 1.73e-06 ft/day (7.59e-03 in/yr)
GHB Inflow Cells = 87
GHB Inflow Area ~ (87 x 5280 x 250) = 1.15e+08
GHB Inflow ~ (153966.16 / 1.15e+08) = 1.34e-03 ft/day (5.86 in/yr)

Table 13. Model Sensitivity Analysis (Kz Conductivity).

Run	Multiplier	Sum of Squares	Residual Mean	Residual Std.	Average Drawdown	CH
Groundwater Vistas Sensitivity Analysis						
Parameter: Kz	Zone: 3		Layer: 2			
Run	Multiplier	Sum of Squares	Residual Mean	Residual Std.	Average Drawdown	CH
1	0.01	1.05E+02	-0.29	1.11	0.02	10404410.14
2	0.1	1.04E+02	-0.29	1.11	0.02	10393397.51
3	1	1.02E+02	-0.23	1.11	0.00	10280772.02
4	10	1.14E+02	0.31	1.15	0.20	9156799.46
5	100	2.42E+03	4.73	2.81	2.07	-600553.57
Groundwater Vistas Sensitivity Analysis						
Parameter: Kz	Zone: 11		Layer: 3			
Run	Multiplier	Sum of Squares	Residual Mean	Residual Std.	Average Drawdown	CH
1	0.01	1.03E+02	-0.23	1.11	0.00	10279615.76
2	0.1	1.02E+02	-0.23	1.11	0.00	10280666.51
3	1	1.02E+02	-0.23	1.11	0.00	10280772.02
4	10	1.02E+02	-0.23	1.11	0.00	10280782.92
5	100	1.02E+02	-0.23	1.11	0.00	10280784.05
Groundwater Vistas Sensitivity Analysis						
Parameter: Kz	Zone: 1		Layer: 4			
Run	Multiplier	Sum of Squares	Residual Mean	Residual Std.	Average Drawdown	CH
1	0.01	1.83E+03	-1.17	4.63	-0.40	9845343.29
2	0.1	4.73E+02	-0.61	2.35	-0.17	10100656.51
3	1	1.02E+02	-0.23	1.11	0.00	10280772.02
4	10	8.38E+01	-0.16	1.01	0.03	10316265.96
5	100	8.25E+01	-0.15	1.01	0.04	10320382.31
Groundwater Vistas Sensitivity Analysis						
Parameter: Kz	Zone: 6		Layer: 5			
Run	Multiplier	Sum of Squares	Residual Mean	Residual Std.	Average Drawdown	CH
1	0.01	1.03E+02	-0.23	1.11	0.00	10277283.22
2	0.1	1.02E+02	-0.23	1.11	0.00	10280455.11
3	1	1.02E+02	-0.23	1.11	0.00	10280772.02
4	10	1.02E+02	-0.23	1.11	0.00	10280803.85
5	100	1.02E+02	-0.23	1.11	0.00	10280807.10
Groundwater Vistas Sensitivity Analysis						
Parameter: Kz	Zone: 4		Layer: 6			
Run	Multiplier	Sum of Squares	Residual Mean	Residual Std.	Average Drawdown	CH
1	0.01	4.04E+03	2.50	6.65	0.54	7105294.96
2	0.1	2.10E+03	1.09	5.01	0.22	8108382.38
3	1	1.02E+02	-0.23	1.11	0.00	10280772.02
4	10	5.49E+02	-0.68	2.53	-0.03	11299480.85
5	100	6.83E+02	-0.74	2.83	-0.02	11452582.49
Groundwater Vistas Sensitivity Analysis						
Parameter: Kz	Zone: 8		Layer: 7			
Run	Multiplier	Sum of Squares	Residual Mean	Residual Std.	Average Drawdown	CH
1	0.01	3.68E+03	5.45	4.04	1.46	1010821.86
2	0.1	2.47E+03	4.40	3.40	1.20	2695700.89
3	1	1.02E+02	-0.23	1.11	0.00	10280772.02
4	10	2.24E+03	-4.32	3.05	-1.13	17379406.79
5	100	3.12E+03	-5.13	3.56	-1.37	18802576.74

Table 13 contd. Model Sensitivity Analysis (Kz Conductivity).

Groundwater Vistas Sensitivity Analysis Parameter: Kz Zone: 2 Layer: 8						
Run	Multiplier	Sum of Squares	Residual Mean	Residual Std.	Average Drawdown	CH
1	0.01	2.69E+03	4.10	4.11	2.47	89497.58
2	0.1	1.61E+03	3.14	3.21	2.12	2103820.83
3	1	1.02E+02	-0.23	1.11	0.00	10280772.02
4	10	1.12E+03	-2.53	2.76	-1.54	18053184.51
5	100	1.47E+03	-2.93	3.12	-1.83	20418121.18

Table 14. Model Sensitivity Analysis (Kx Conductivity).

Groundwater Vistas Sensitivity Analysis						
Parameter: Kx	Zone: 3		Layer: 2			
Run	Multiplier	Sum of Squares	Residual Mean	Residual Std.	Average Drawdown	CH
1	0.01	1.02E+02	-0.23	1.11	-0.03	10279231.65
2	0.1	1.02E+02	-0.23	1.11	-0.03	10279161.38
3	1	1.02E+02	-0.23	1.11	0.00	10280772.02
4	10	1.02E+02	-0.23	1.11	0.04	10283592.47
5	100	1.02E+02	-0.23	1.11	0.07	10286210.61
Groundwater Vistas Sensitivity Analysis						
Parameter: Kx	Zone: 11		Layer: 3			
Run	Multiplier	Sum of Squares	Residual Mean	Residual Std.	Average Drawdown	CH
1	0.01	3.06E+03	-5.28	3.24	-1.88	9783171.28
2	0.1	2.01E+03	-4.25	2.67	-1.47	9888377.47
3	1	1.02E+02	-0.23	1.11	0.00	10280772.02
4	10	1.01E+03	2.83	2.14	1.12	10579717.45
5	100	1.27E+03	3.10	2.50	1.27	10623275.44
Groundwater Vistas Sensitivity Analysis						
Parameter: Kx	Zone: 1		Layer: 4			
Run	Multiplier	Sum of Squares	Residual Mean	Residual Std.	Average Drawdown	CH
1	0.01	1.03E+02	-0.23	1.11	0.00	10280490.30
2	0.1	1.03E+02	-0.23	1.11	0.00	10280516.00
3	1	1.02E+02	-0.23	1.11	0.00	10280772.02
4	10	1.00E+02	-0.21	1.10	0.01	10283270.12
5	100	8.83E+01	0.00	1.05	0.08	10304853.48
Groundwater Vistas Sensitivity Analysis						
Parameter: Kx	Zone: 6		Layer: 5			
Run	Multiplier	Sum of Squares	Residual Mean	Residual Std.	Average Drawdown	CH
1	0.01	7.87E+02	-2.49	1.91	-0.91	10019154.95
2	0.1	6.17E+02	-2.15	1.75	-0.76	10059008.68
3	1	1.02E+02	-0.23	1.11	0.00	10280772.02
4	10	1.33E+03	3.39	2.27	1.33	10679249.78
5	100	3.04E+03	5.34	3.07	2.16	10901715.65
Groundwater Vistas Sensitivity Analysis						
Parameter: Kx	Zone: 4		Layer: 6			
Run	Multiplier	Sum of Squares	Residual Mean	Residual Std.	Average Drawdown	CH
1	0.01	2.03E+02	-0.69	1.44	-0.18	10181686.71
2	0.1	1.77E+02	-0.61	1.36	-0.16	10194500.73
3	1	1.02E+02	-0.23	1.11	0.00	10280772.02
4	10	1.83E+02	0.96	1.17	0.44	10513926.92
5	100	5.81E+02	1.98	1.83	0.83	10693187.99
Groundwater Vistas Sensitivity Analysis						
Parameter: Kx	Zone: 8		Layer: 7			
Run	Multiplier	Sum of Squares	Residual Mean	Residual Std.	Average Drawdown	CH
1	0.01	1.74E+02	-0.41	1.41	-0.22	10035893.95
2	0.1	1.52E+02	-0.45	1.31	-0.19	10051205.43
3	1	1.02E+02	-0.23	1.11	0.00	10280772.02
4	10	9.84E+01	0.35	1.05	0.27	10728705.39
5	100	2.87E+02	1.01	1.60	0.50	11301944.09

Table 14 contd. Model Sensitivity Analysis (Kx Conductivity).

Groundwater Vistas Sensitivity Analysis

Parameter: Kx Zone: 2 Layer: 8

Run	Multiplier	Sum of Squares	Residual Mean	Residual Std.	Average Drawdown	CH
1	0.01	1.02E+02	-0.23	1.11	0.00	10274601.30
2	0.1	1.02E+02	-0.23	1.11	0.00	10271663.27
3	1	1.02E+02	-0.23	1.11	0.00	10280772.02
4	10	1.04E+02	-0.21	1.12	0.00	10399744.03
5	100	1.13E+02	-0.11	1.19	0.02	10979058.71

Table 15. Model Sensitivity Analysis (GHB Conductance).

Groundwater Vistas Sensitivity Analysis						
Parameter: GHB Conductance		Reach: 3		Layer: 2		
Run	Multiplier	Sum of Squares	Residual Mean	Residual Std.	Average Drawdown	CH
1	0.01	3.76E+02	-1.78	1.24	-0.65	10135565.04
2	0.1	1.77E+02	-1.00	1.10	-0.32	10209702.19
3	1	1.02E+02	-0.23	1.11	0.00	10280772.02
4	10	1.02E+02	-0.07	1.13	0.06	10295128.84
5	100	1.03E+02	-0.06	1.13	0.07	10296561.45
Groundwater Vistas Sensitivity Analysis						
Parameter: GHB Conductance		Reach: 11		Layer: 3		
Run	Multiplier	Sum of Squares	Residual Mean	Residual Std.	Average Drawdown	CH
1	0.01	1.02E+02	-0.23	1.11	0.00	10280772.02
2	0.1	1.02E+02	-0.23	1.11	0.00	10280772.02
3	1	1.02E+02	-0.23	1.11	0.00	10280772.02
4	10	1.02E+02	-0.23	1.11	0.00	10280772.02
5	100	1.02E+02	-0.23	1.11	0.00	10280772.02
Groundwater Vistas Sensitivity Analysis						
Parameter: GHB Conductance		Reach: 1		Layer: 4		
Run	Multiplier	Sum of Squares	Residual Mean	Residual Std.	Average Drawdown	CH
1	0.01	1.02E+02	-0.23	1.11	0.00	10280772.02
2	0.1	1.02E+02	-0.23	1.11	0.00	10280772.02
3	1	1.02E+02	-0.23	1.11	0.00	10280772.02
4	10	1.02E+02	-0.23	1.11	0.00	10280772.02
5	100	1.02E+02	-0.23	1.11	0.00	10280772.02
Groundwater Vistas Sensitivity Analysis						
Parameter: GHB Conductance		Reach: 6		Layer: 5		
Run	Multiplier	Sum of Squares	Residual Mean	Residual Std.	Average Drawdown	CH
1	0.01	1.12E+02	-0.33	1.14	-0.09	10240765.16
2	0.1	1.08E+02	-0.30	1.13	-0.06	10255528.56
3	1	1.02E+02	-0.23	1.11	0.00	10280772.02
4	10	1.01E+02	-0.21	1.10	0.02	10288308.43
5	100	1.01E+02	-0.20	1.10	0.02	10289192.79
Groundwater Vistas Sensitivity Analysis						
Parameter: GHB Conductance		Reach: 4		Layer: 6		
Run	Multiplier	Sum of Squares	Residual Mean	Residual Std.	Average Drawdown	CH
1	0.01	1.02E+02	-0.23	1.11	0.00	10280501.01
2	0.1	1.02E+02	-0.23	1.11	0.00	10280529.73
3	1	1.02E+02	-0.23	1.11	0.00	10280772.02
4	10	1.02E+02	-0.22	1.11	0.01	10281750.74
5	100	1.02E+02	-0.21	1.11	0.01	10282738.61
Groundwater Vistas Sensitivity Analysis						
Parameter: GHB Conductance		Reach: 8		Layer: 7		
Run	Multiplier	Sum of Squares	Residual Mean	Residual Std.	Average Drawdown	CH
1	0.01	1.02E+02	-0.23	1.11	0.00	10255914.65
2	0.1	1.02E+02	-0.23	1.11	0.00	10253658.31
3	1	1.02E+02	-0.23	1.11	0.00	10280772.02
4	10	1.02E+02	-0.23	1.11	0.00	10343935.18
5	100	1.02E+02	-0.23	1.11	0.00	10359830.04

Table 15 contd. Model Sensitivity Analysis (GHB Conductance).

Groundwater Vistas Sensitivity Analysis

Parameter: GHB Conductance   Reach: 2   Layer: 8

Run	Multiplier	Sum of Squares	Residual Mean	Residual Std.	Average Drawdown	CH
1	0.01	1.02E+02	-0.23	1.11	-0.01	10279782.75
2	0.1	1.02E+02	-0.23	1.11	0.00	10280390.44
3	1	1.02E+02	-0.23	1.11	0.00	10280772.02
4	10	1.02E+02	-0.23	1.11	0.00	10280752.48
5	100	1.02E+02	-0.23	1.11	0.00	10280727.94

APPENDIX 1

MODFLOW INPUT FILES

Package	Unit No.	File Type	File Name
Basic	1	ASCII	gvmod.bas
Block Centered Flow	11	ASCII	gvmod.bcf
General Head Boundary	17	ASCII	gvmod.ghb
Output Control	22	ASCII	gvmod.oc
PCG Solver	19	ASCII	gvmod.pcg
Well	12	ASCII	gvmod.wel

MODFLOW OUTPUT FILES

Package	Unit No.	File Type	File Name
Cell by Cell Flow	10	BINARY	gvmod.cbw
Cell by Cell Flow	13	BINARY	gvmod.cbg
Cell by Cell Flow	50	BINARY	gvmod.cbb
Drawdown	31	BINARY	gvmod.ddn
Head Output	30	BINARY	gvmod.hds
MODFLOW		ASCII	gvmod.out